US006313982B1

(12) **United States Patent**
Hino

(10) **Patent No.: US 6,313,982 B1**
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(54) **PROTECTIVE CASE FOR PORTABLE ELECTRONIC APPARATUS**

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(73) Assignee: **Sony Computer Entertainment, Inc.**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/402,622**

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§ 371 Date: **Jan. 12, 2000**

§ 102(e) Date: **Jan. 12, 2000**

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PCT Pub. Date: **Aug. 19, 1999**

(30) **Foreign Application Priority Data**

Feb. 16, 1998 (JP) 10-050154

(51) **Int. Cl.**[7] **H05K 5/00**
(52) **U.S. Cl.** **361/679**; 206/320
(58) **Field of Search** 150/154, 165; 174/17.05, 17.06, 50.5, 50.51, 52.1; 206/305, 320, 521, 592, 701; 361/600, 679, 728, 730, 752, 807, 809, 814

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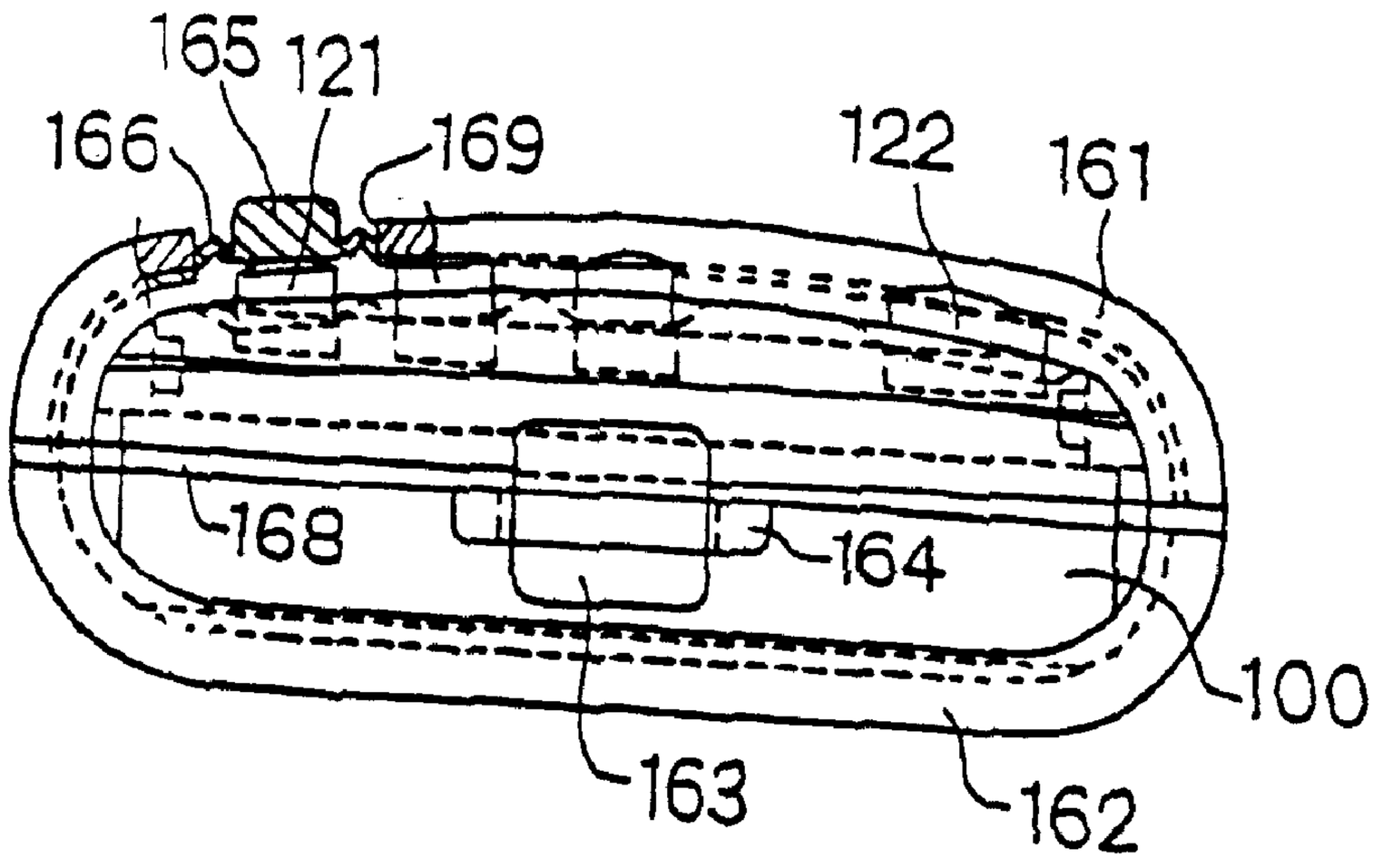
Primary Examiner—Gregory Thompson
(74) *Attorney, Agent, or Firm*—Helfgott & Karas, PC

(57) **ABSTRACT**

Disclosed is a protective case for protecting a portable electronic device against moisture and dust so that the device can be carried anywhere. The protective case has an upper case and a lower case which, by being abutted against each other, form a closed space in a interior of which the portable electronic device **(100)** is capable of being accommodated. Provided in at least one of the cases is a through-hole at a position opposing an operating element of the portable electronic device accommodated inside the space. The through-hole is closed by a closure member **(167)** comprising an elastic material and having a push-button **(165)** that is capable of pushing the operating element of the portable electronic device from the outside. Furthermore, the abutting portion of each case is sealed by a sealing member comprising an elastic material, whereby moisture and dust are positively prevented from penetrating the interior.

37 Claims, 43 Drawing Sheets



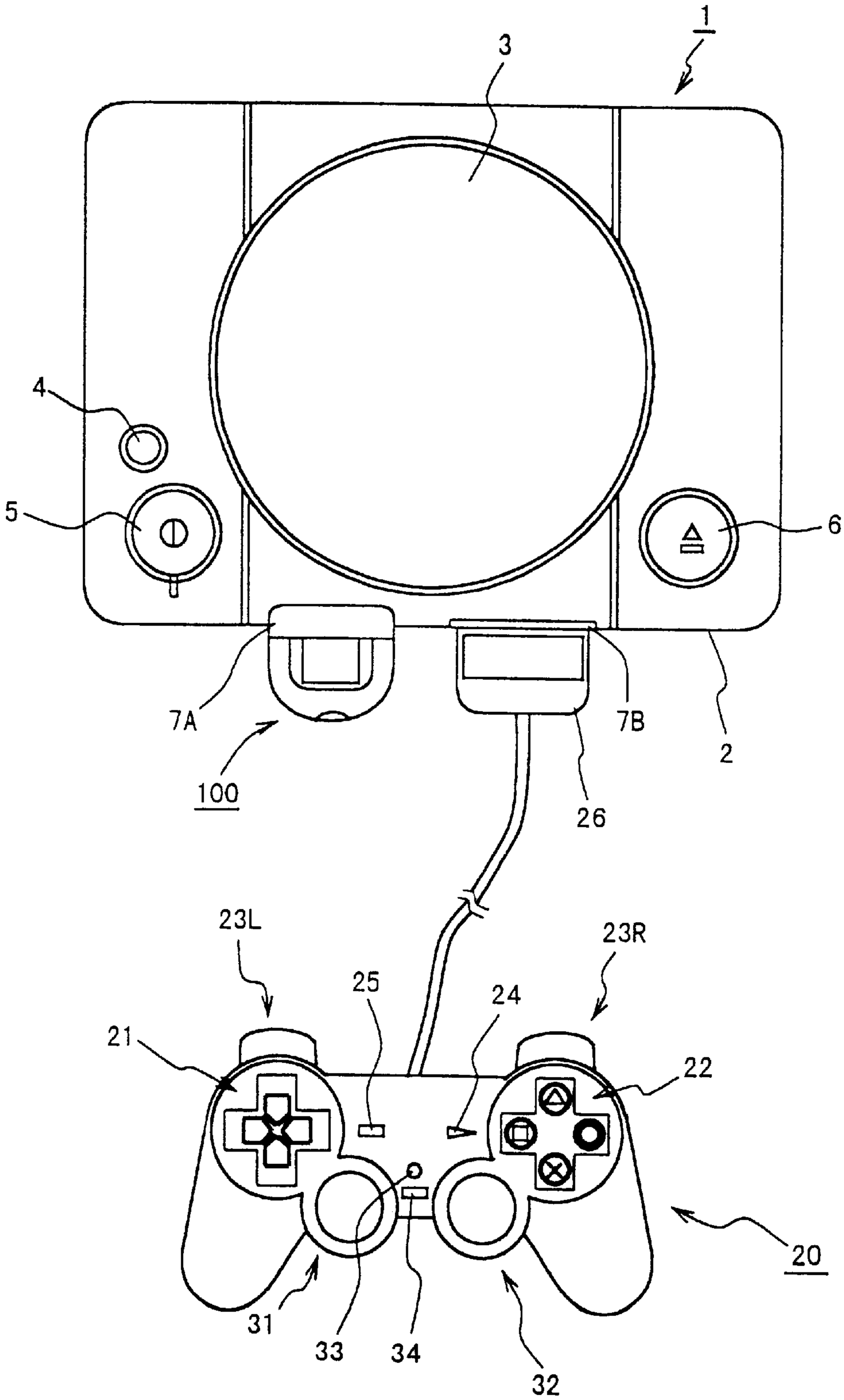


FIG. 1

FIG. 2

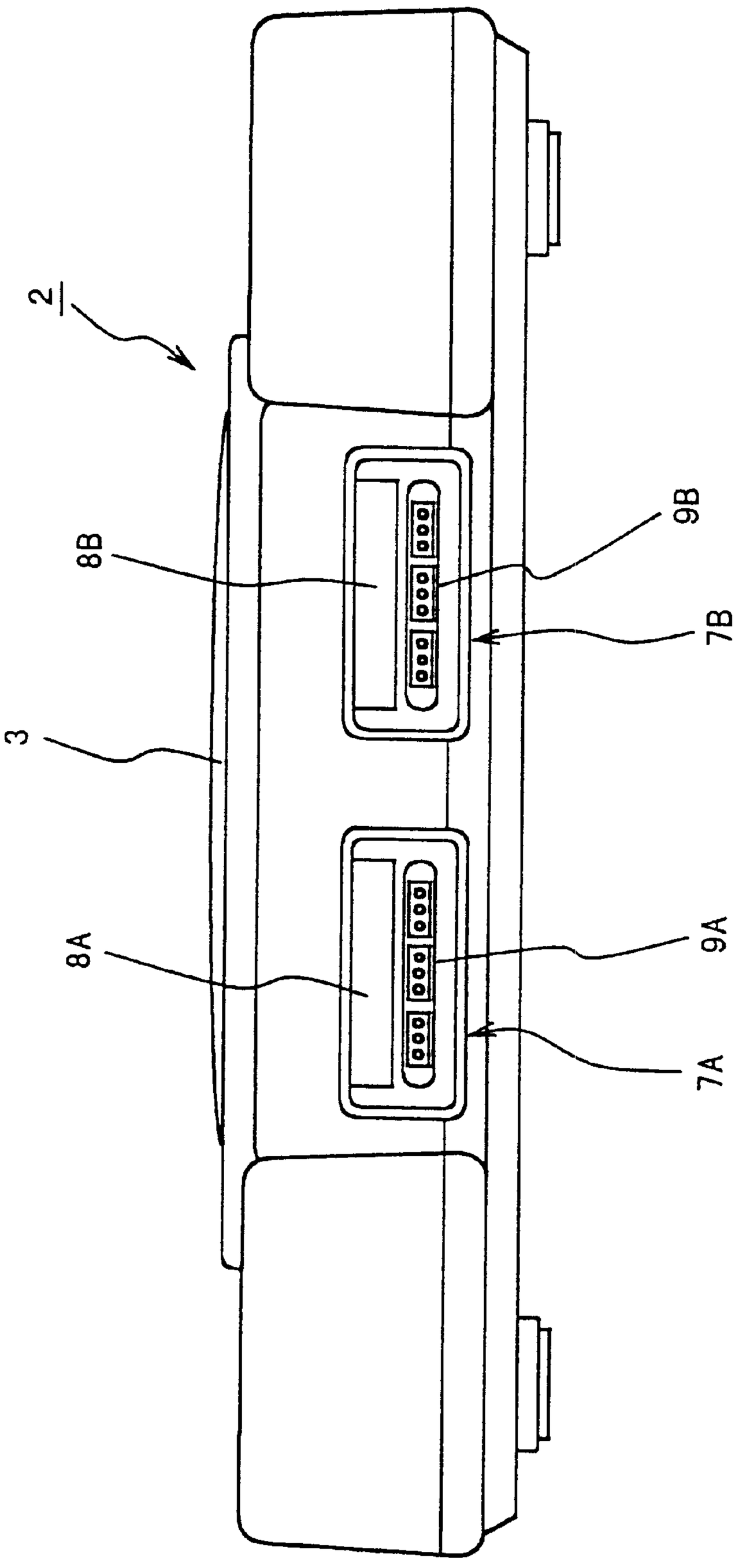
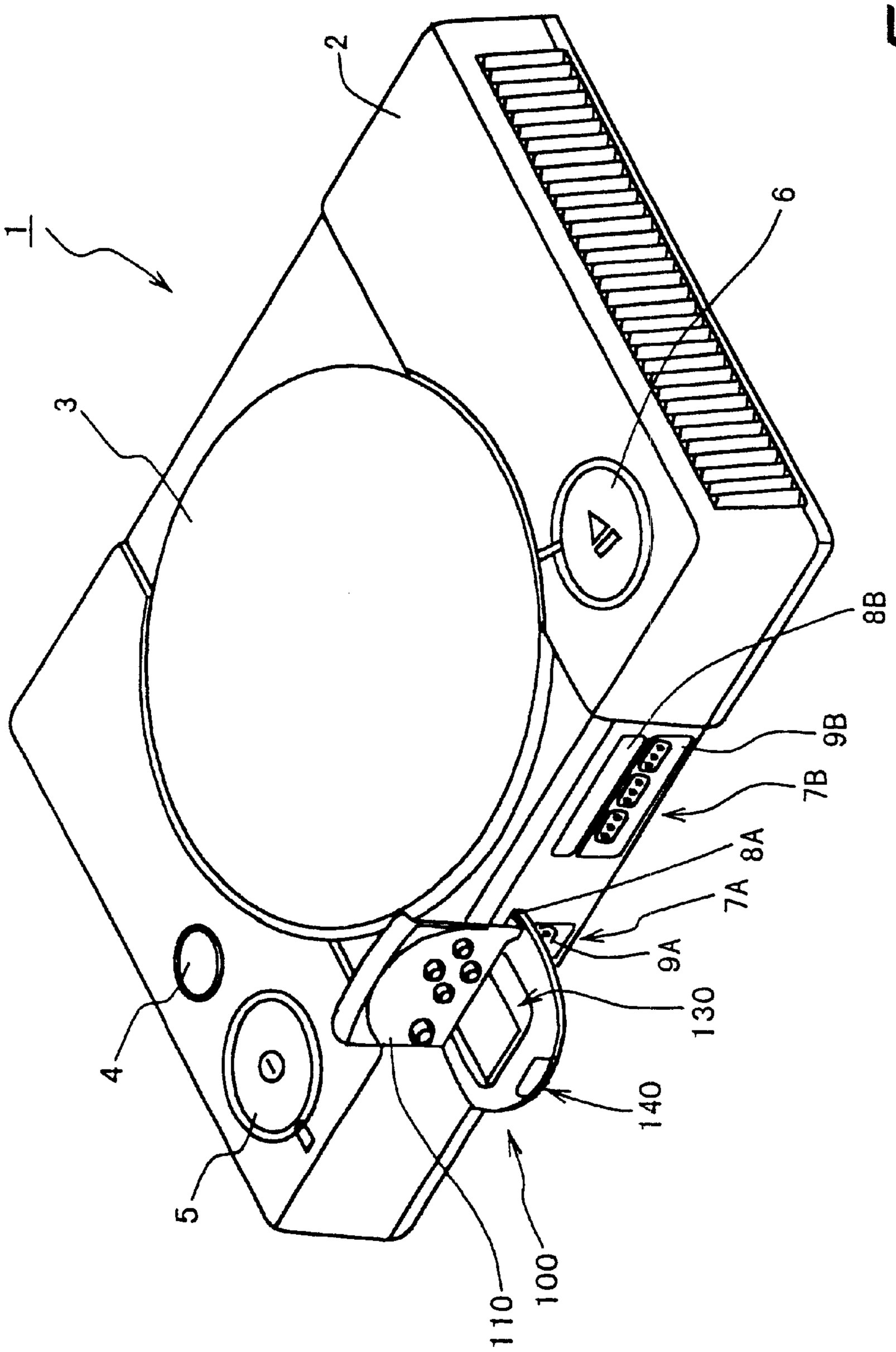


FIG. 3



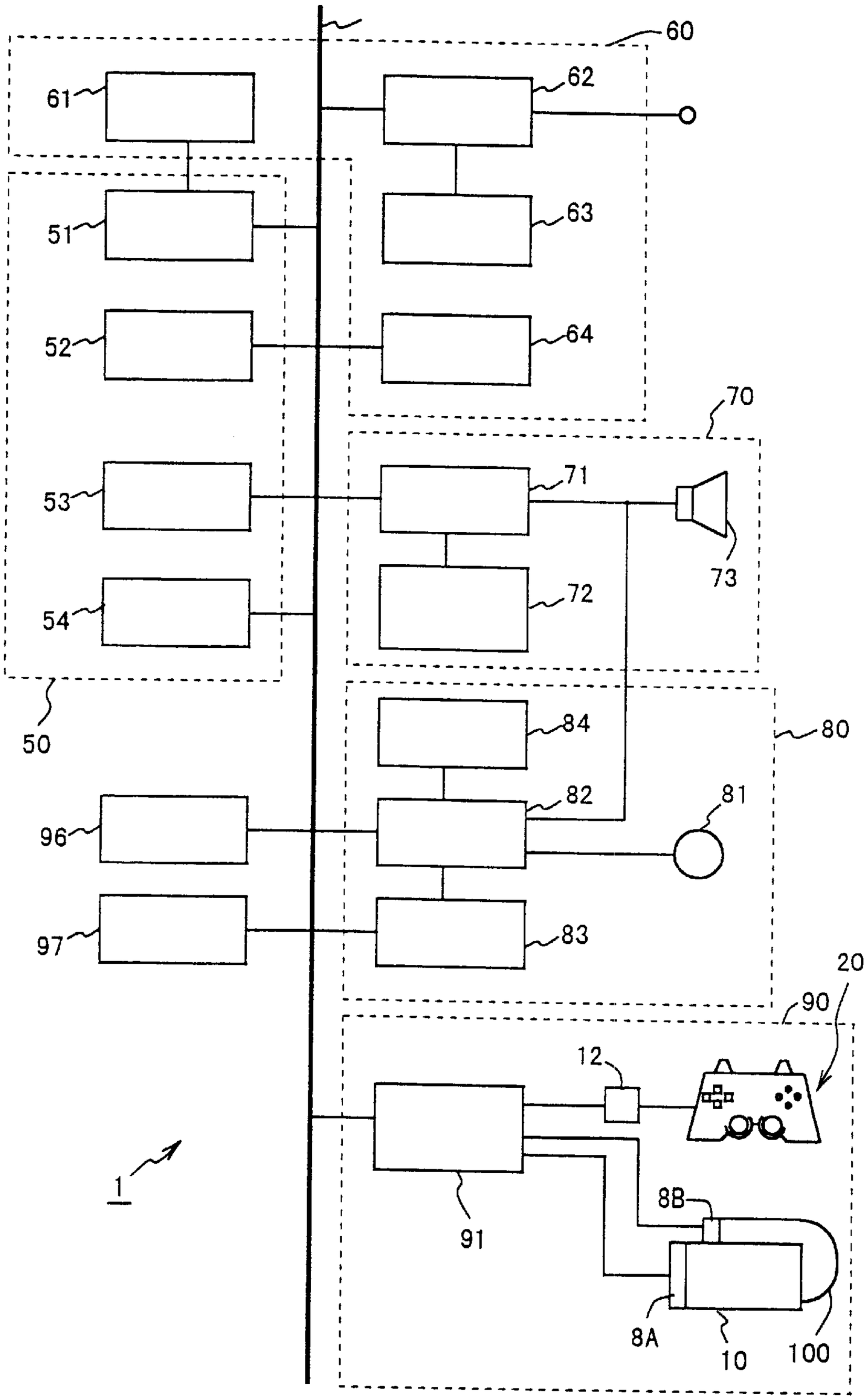

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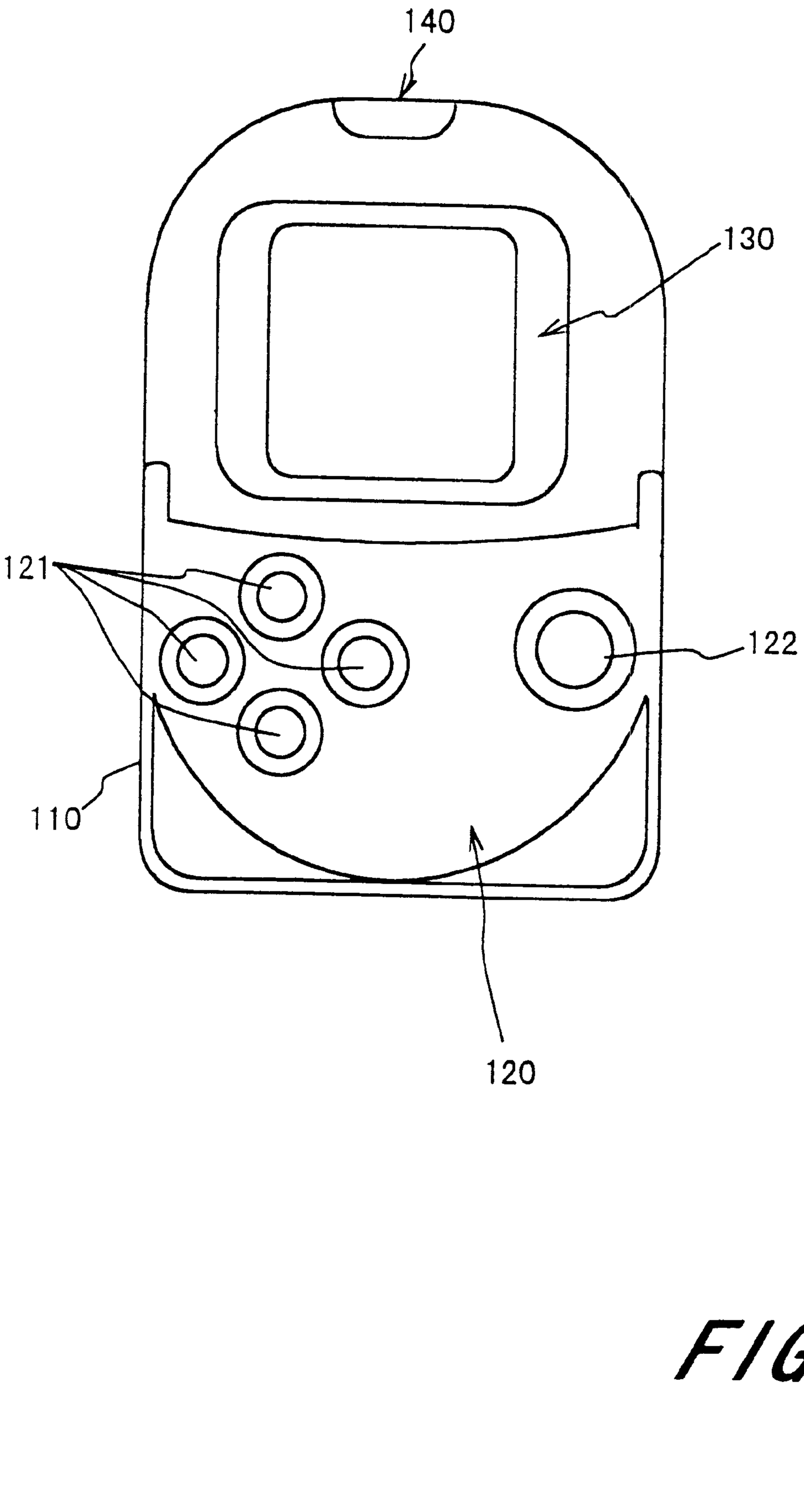
FIG. 4



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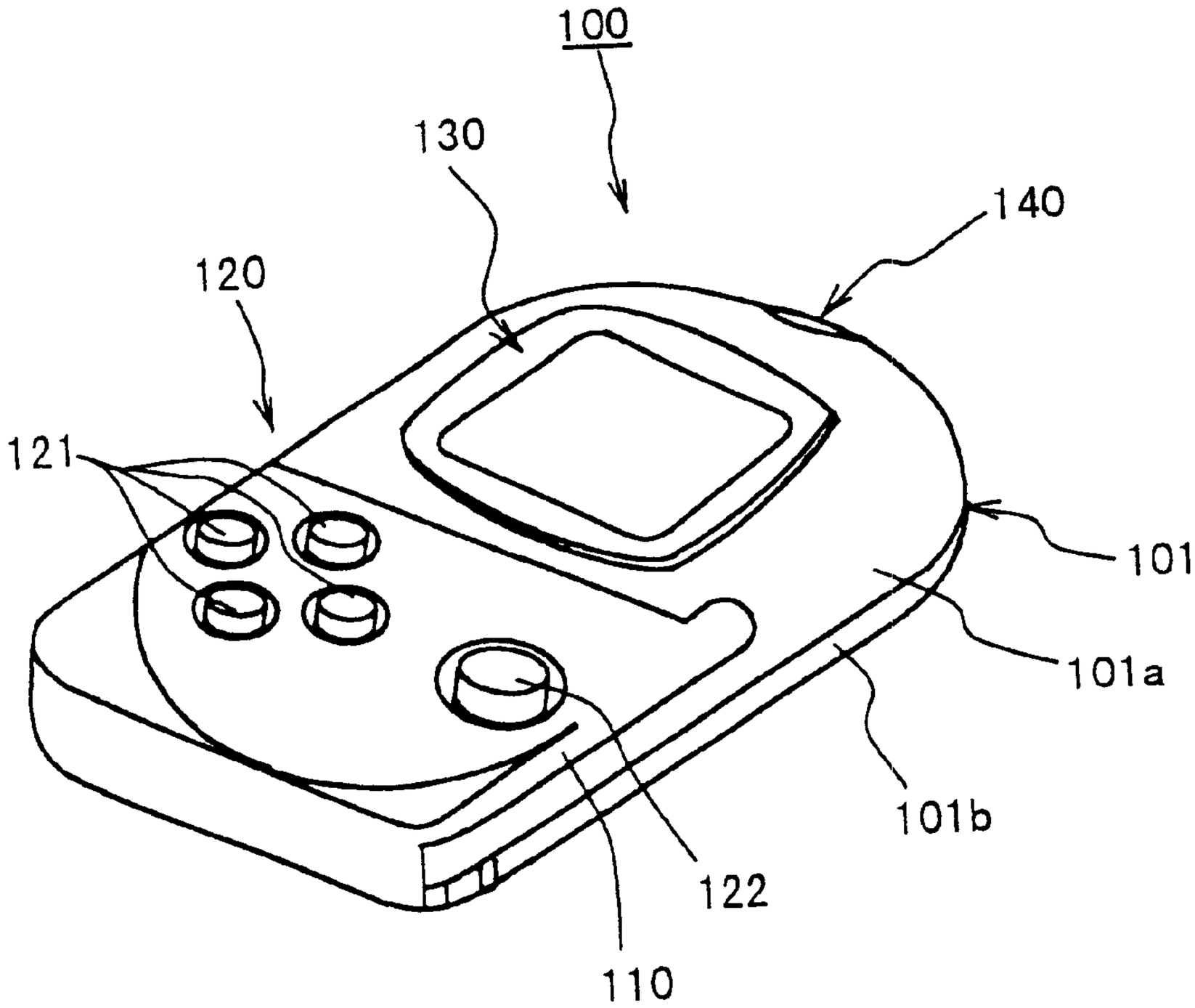

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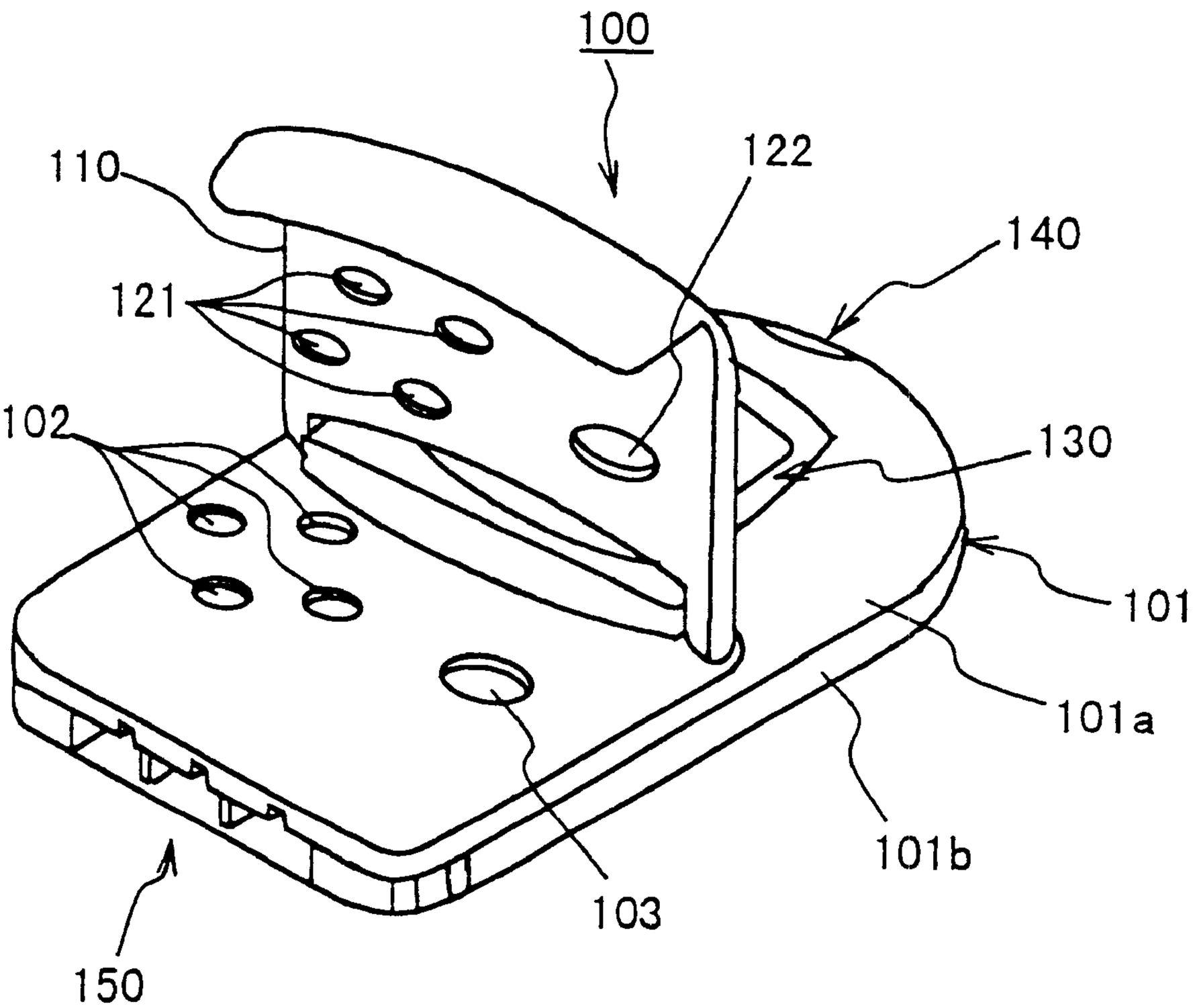

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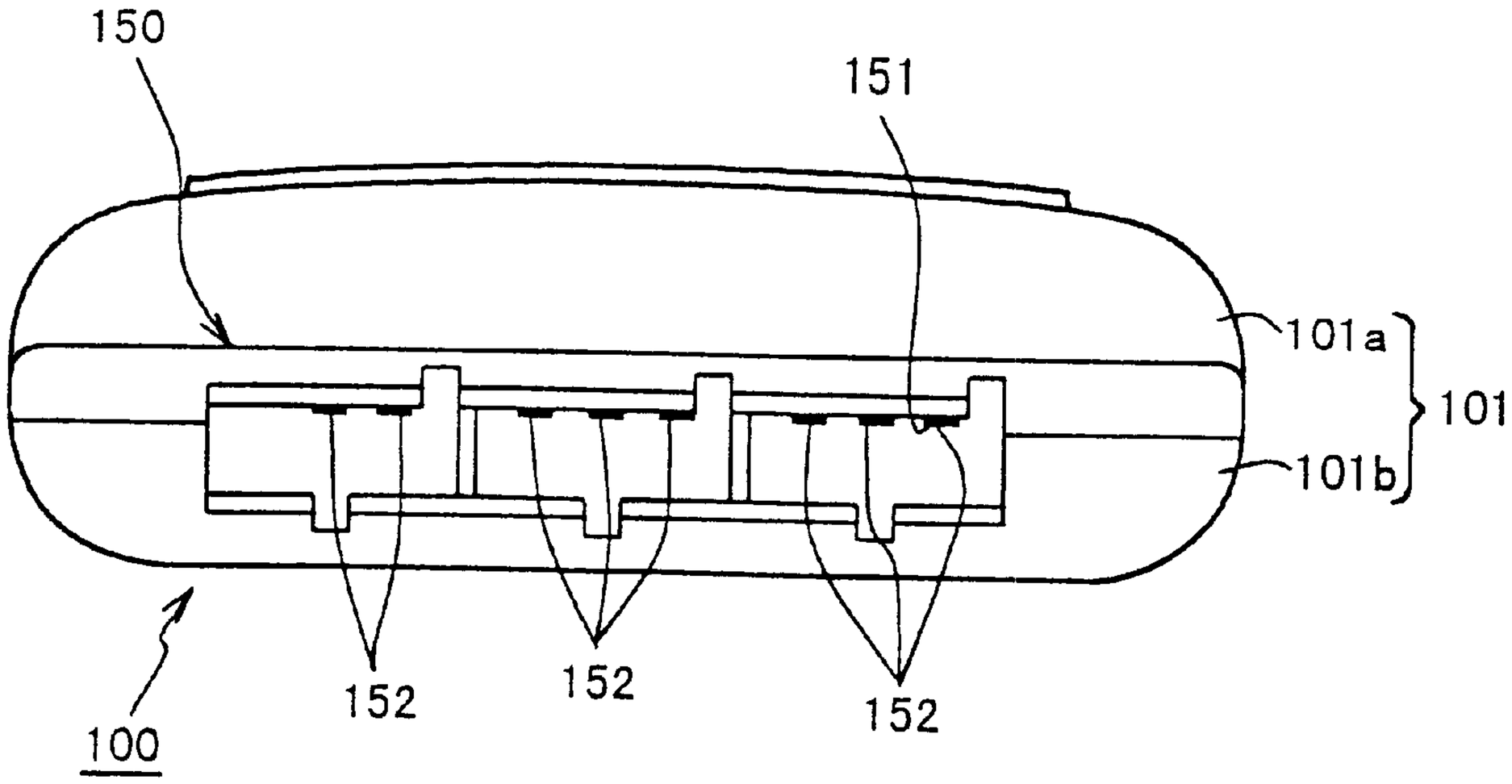
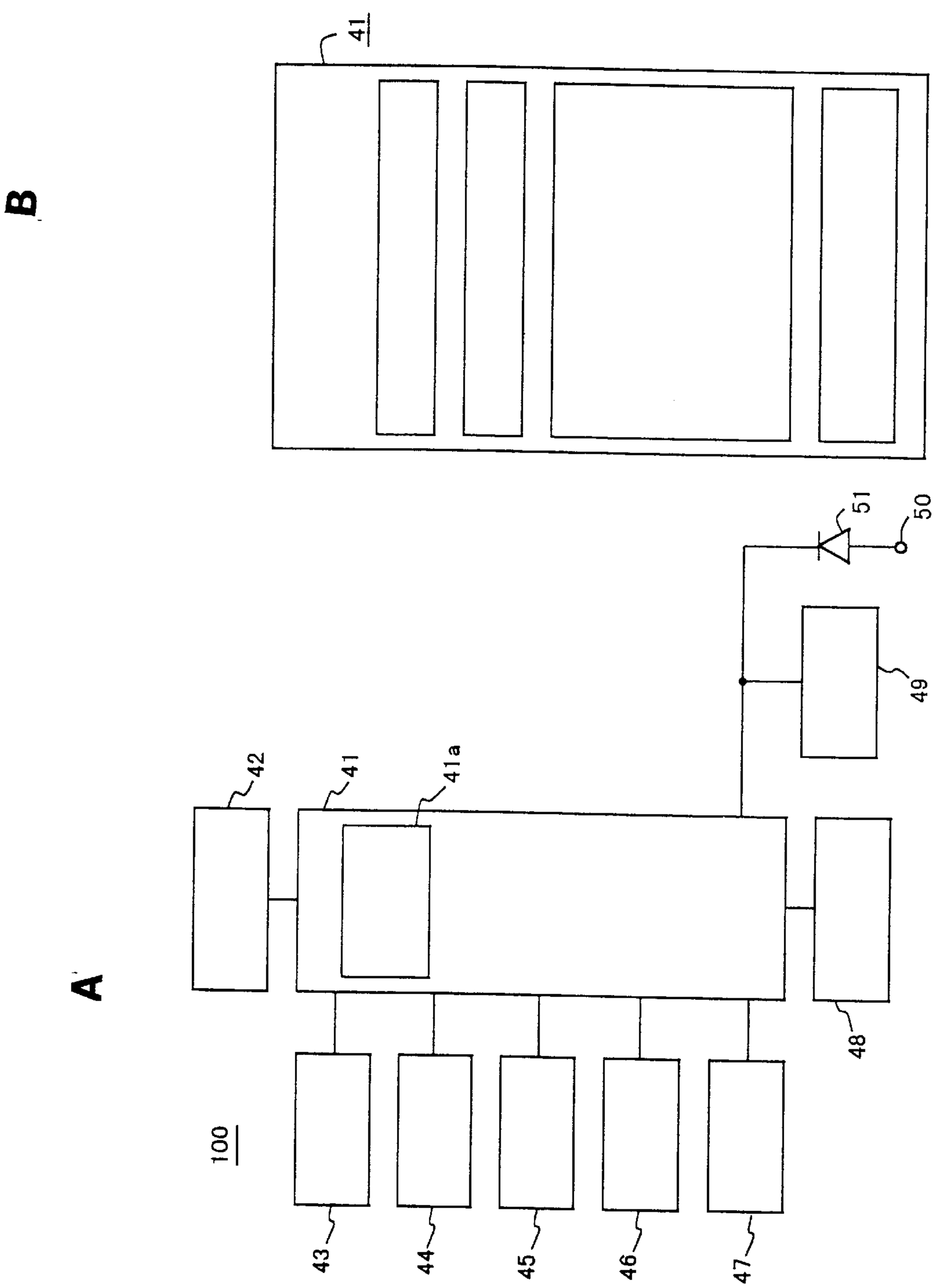
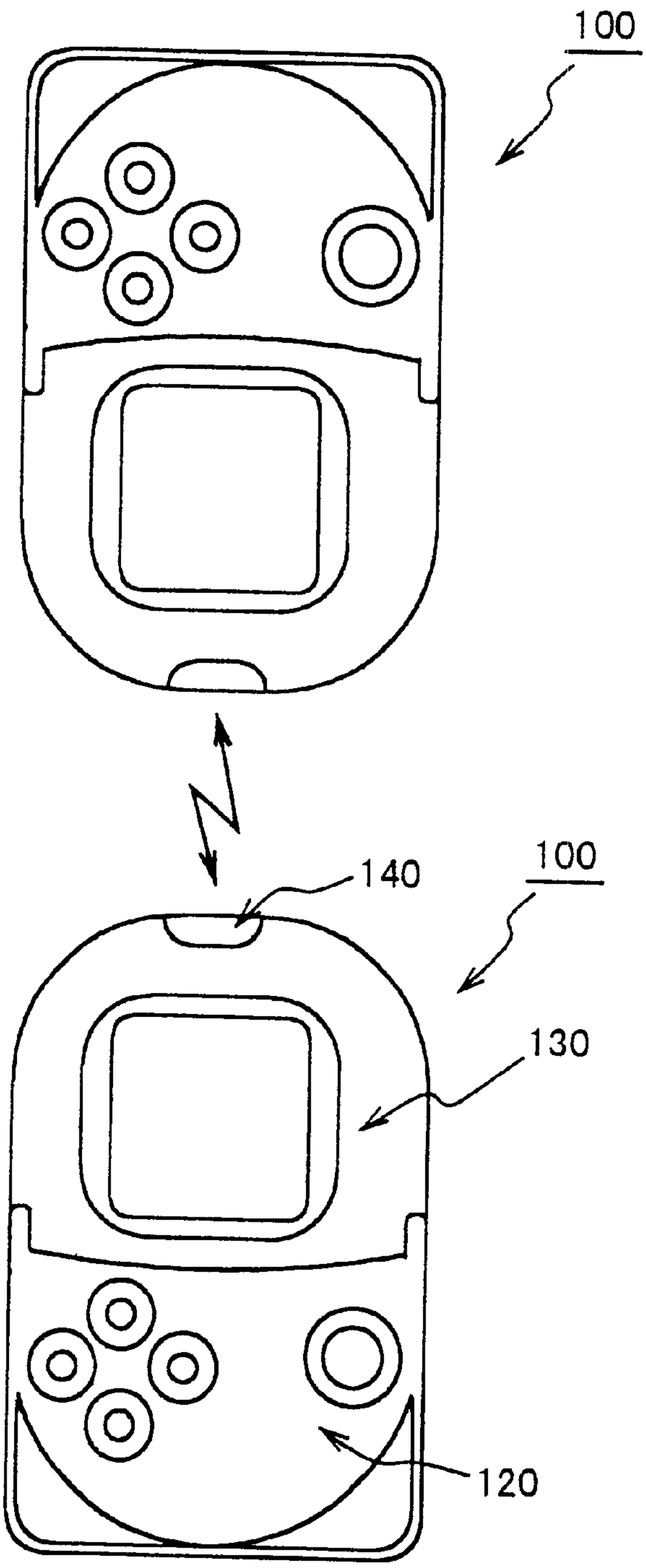


FIG. 8

FIG. 9





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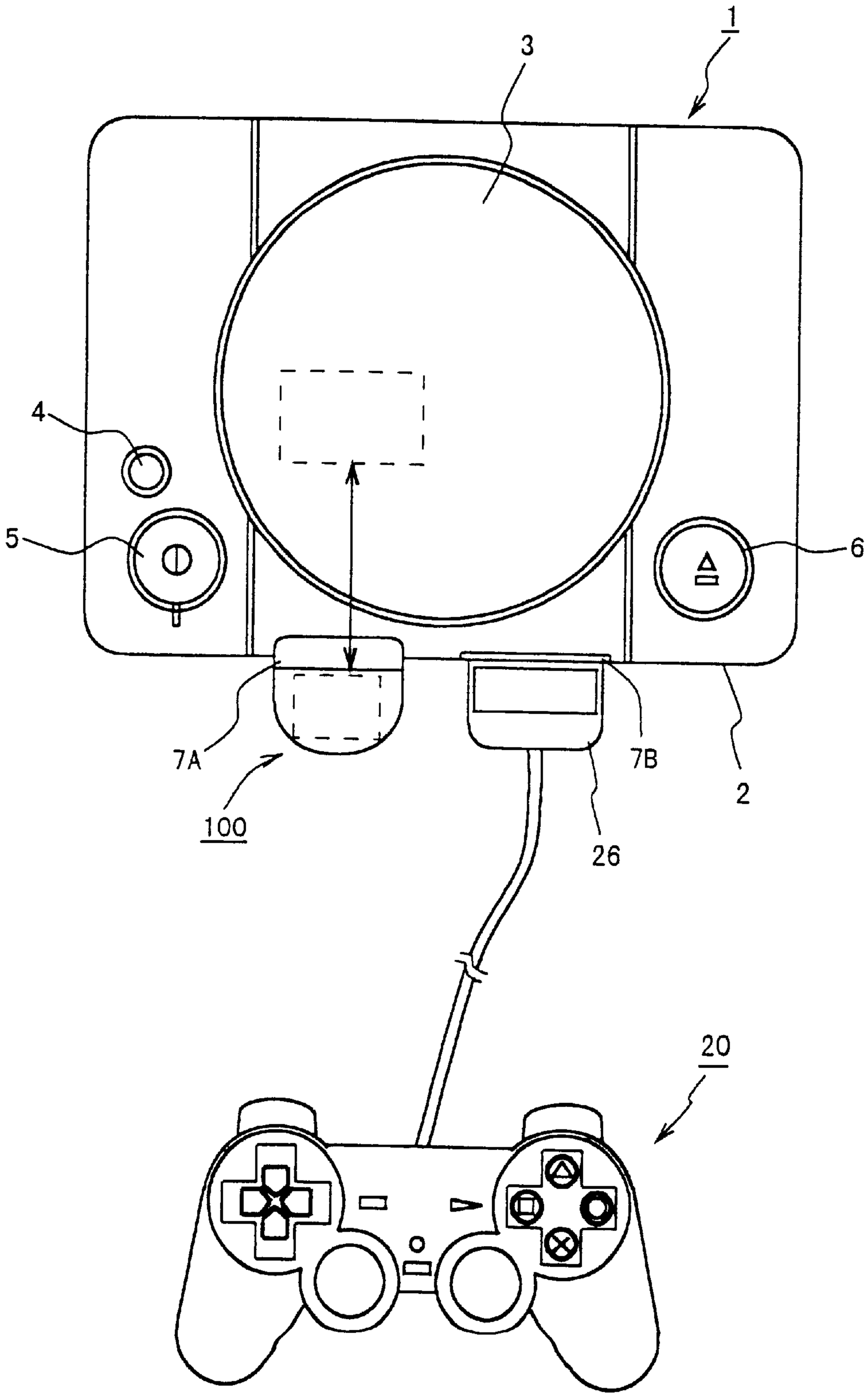

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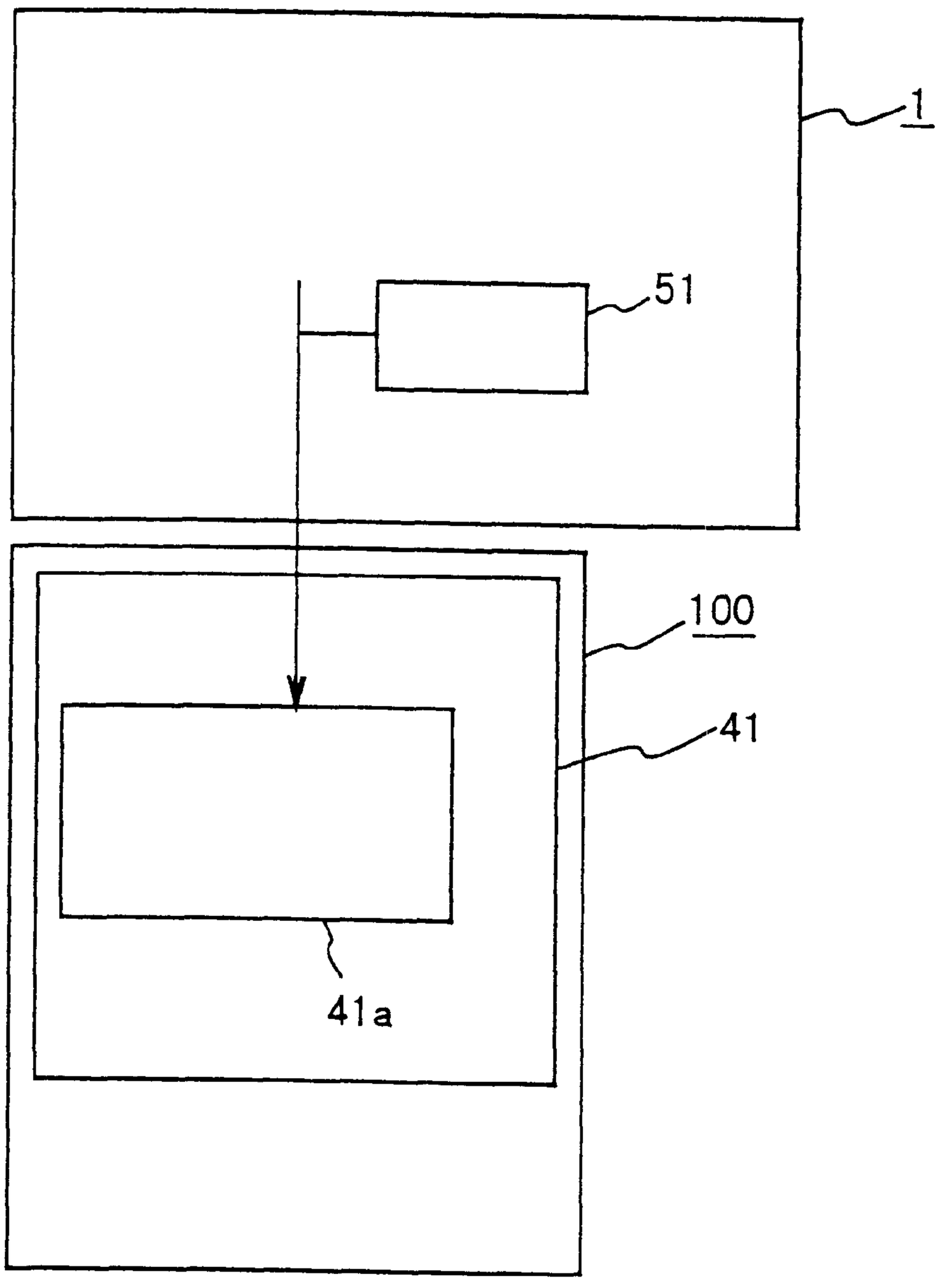

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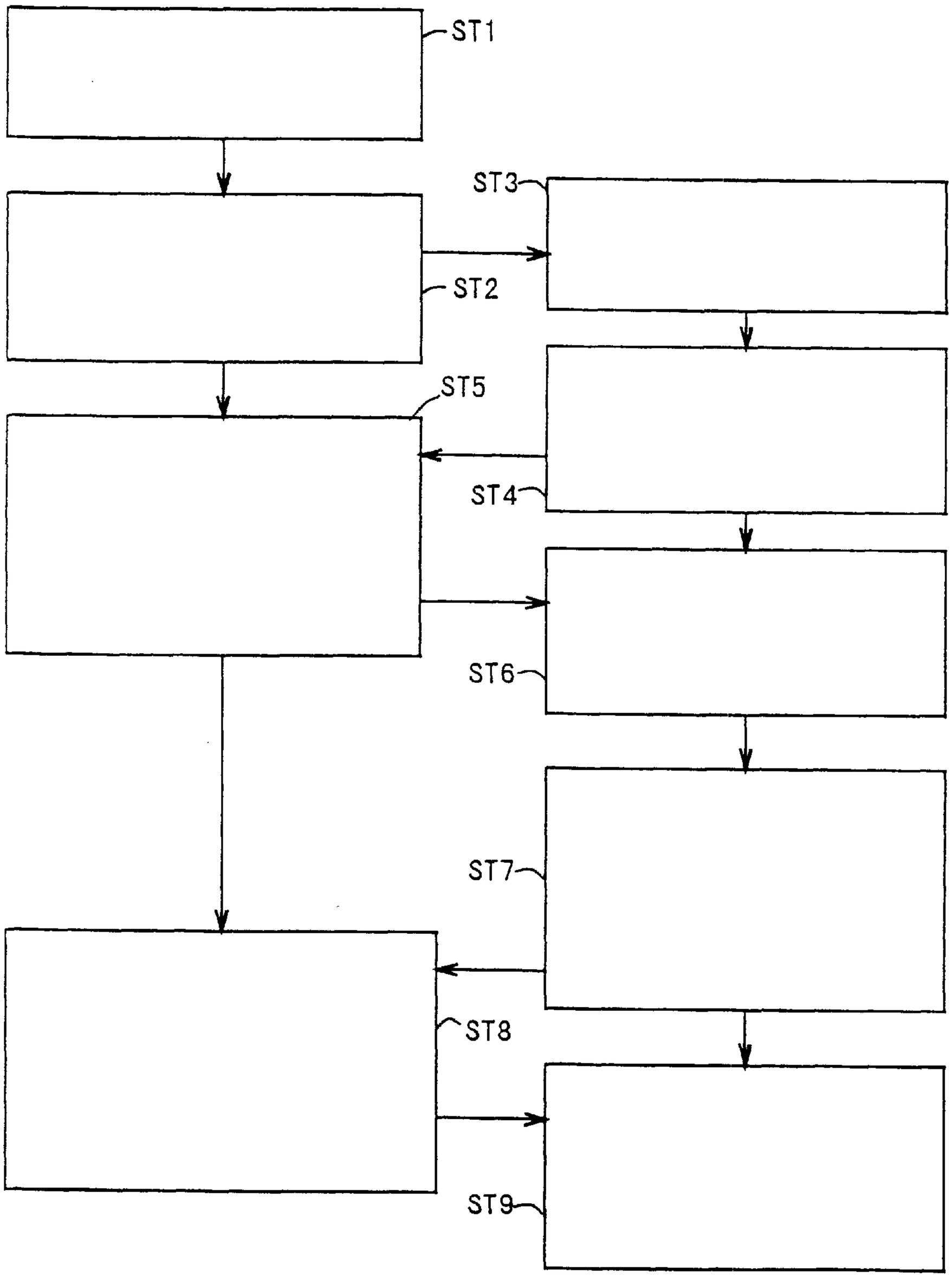

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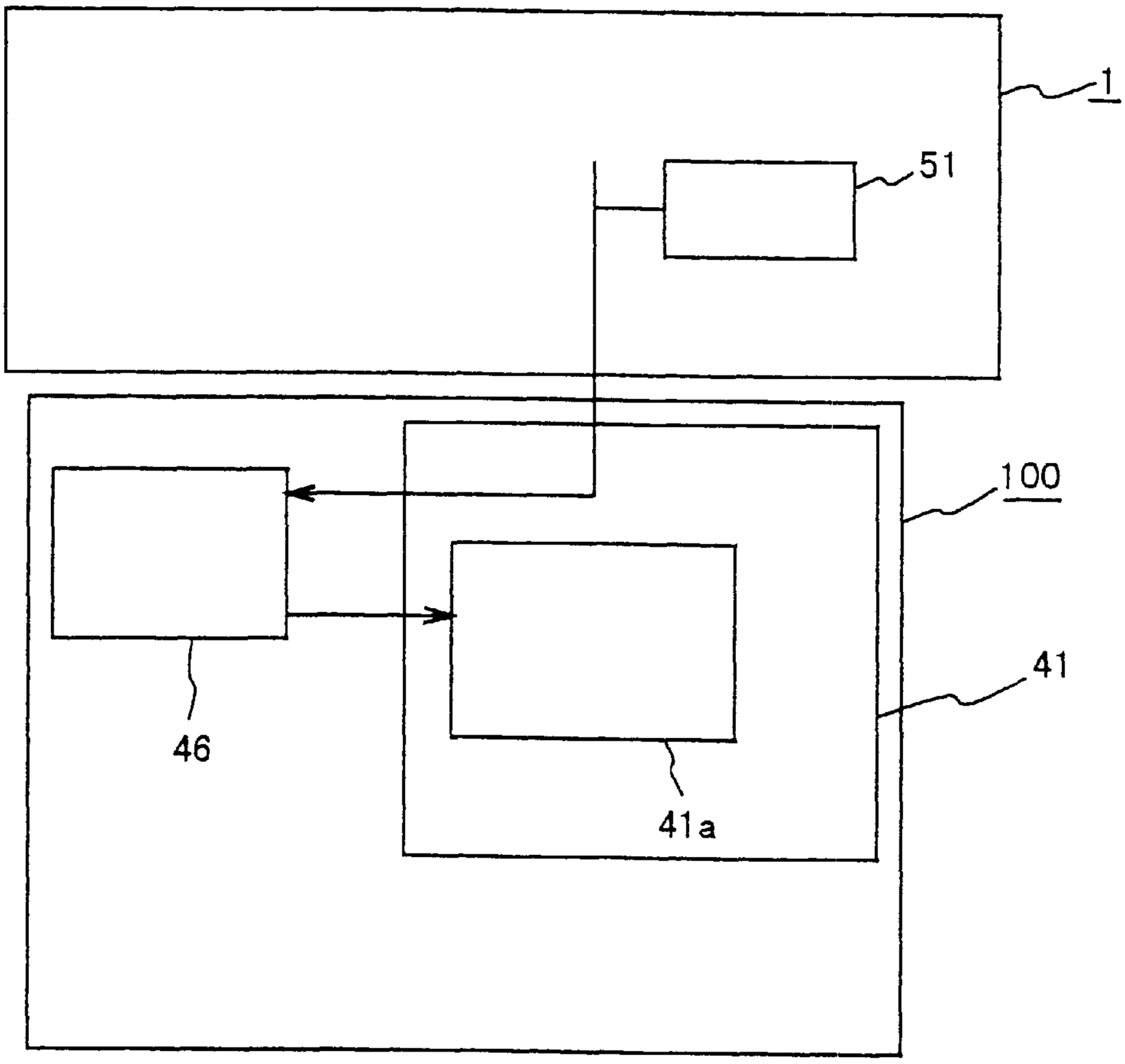

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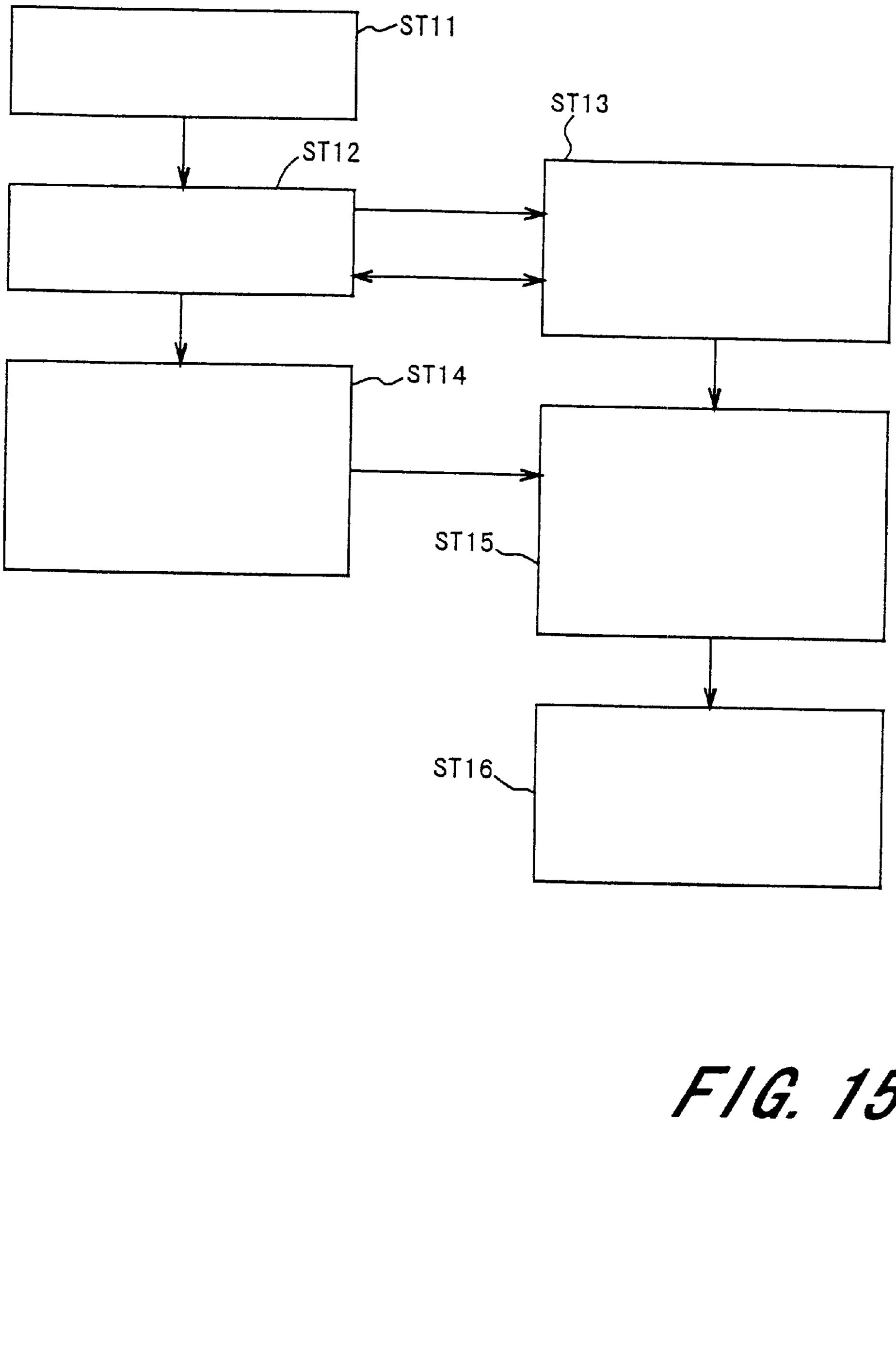


FIG. 15

FIG. 16A

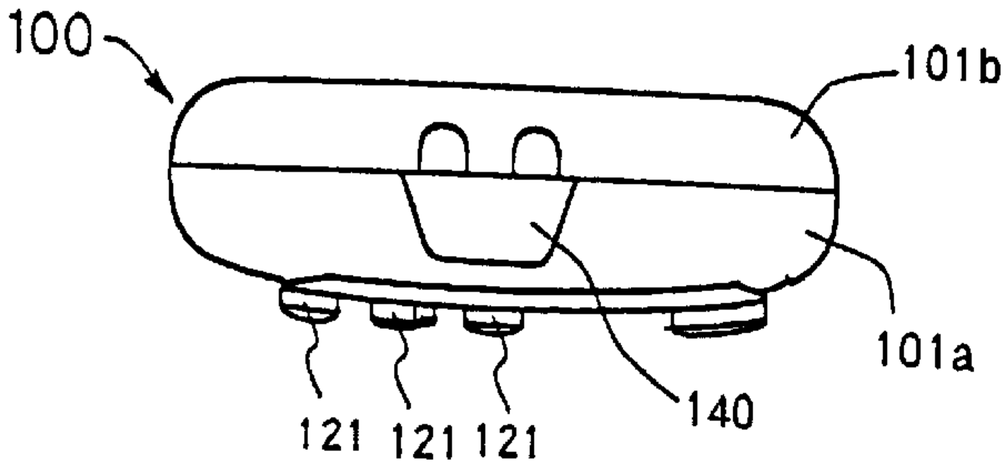


FIG. 16B

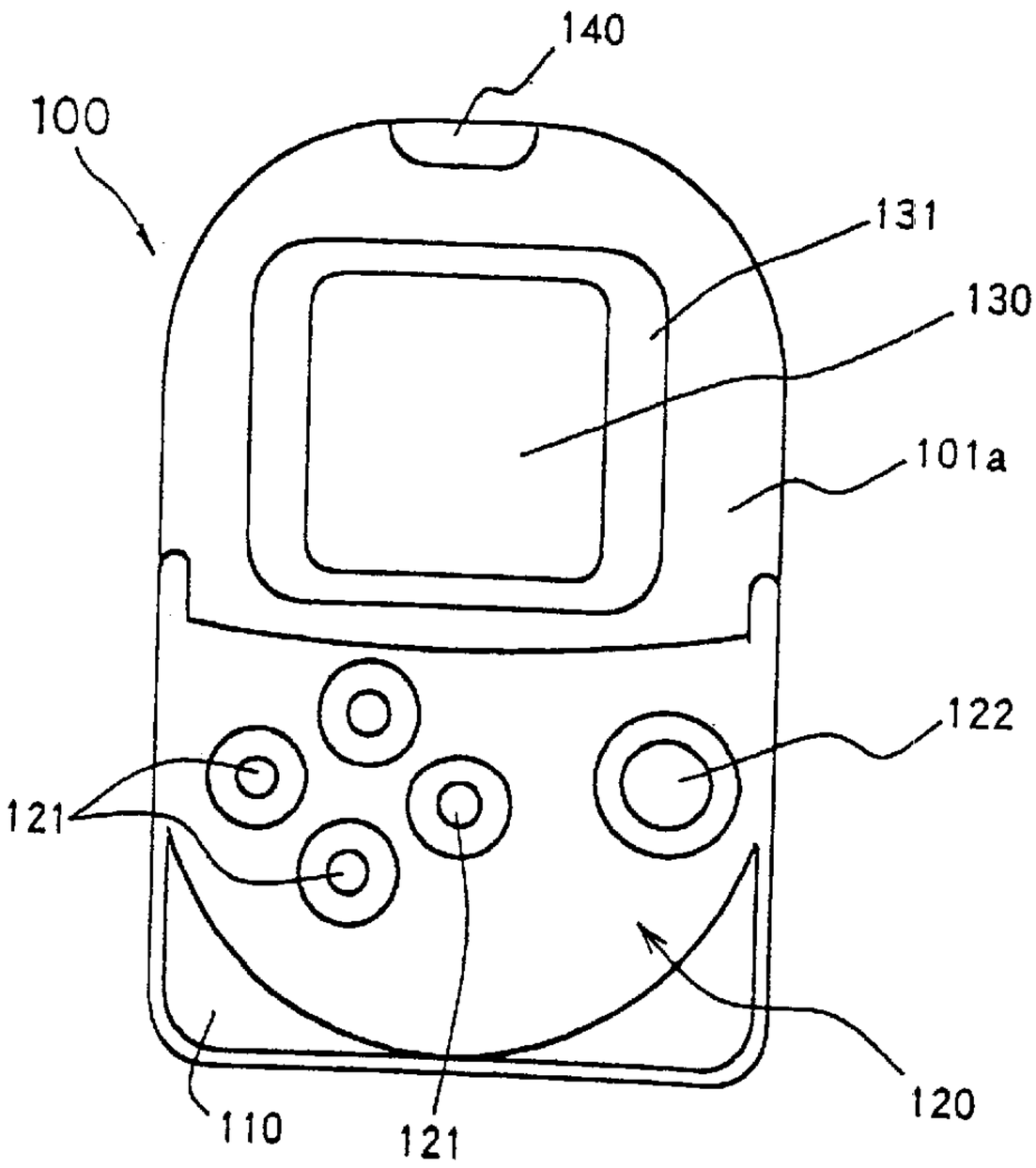
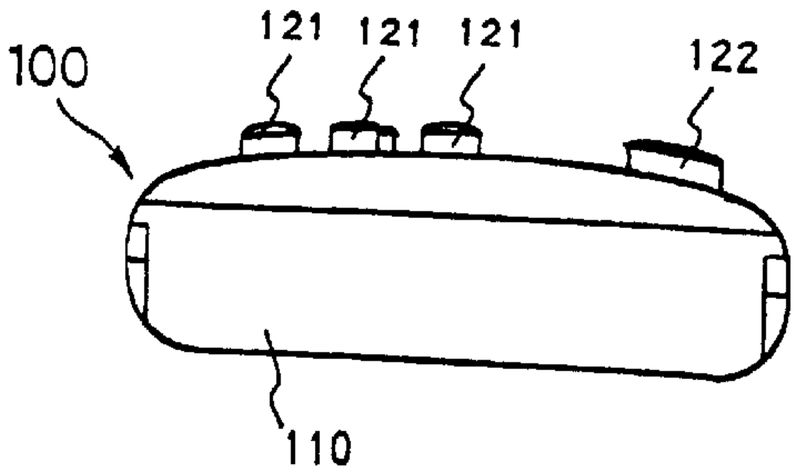
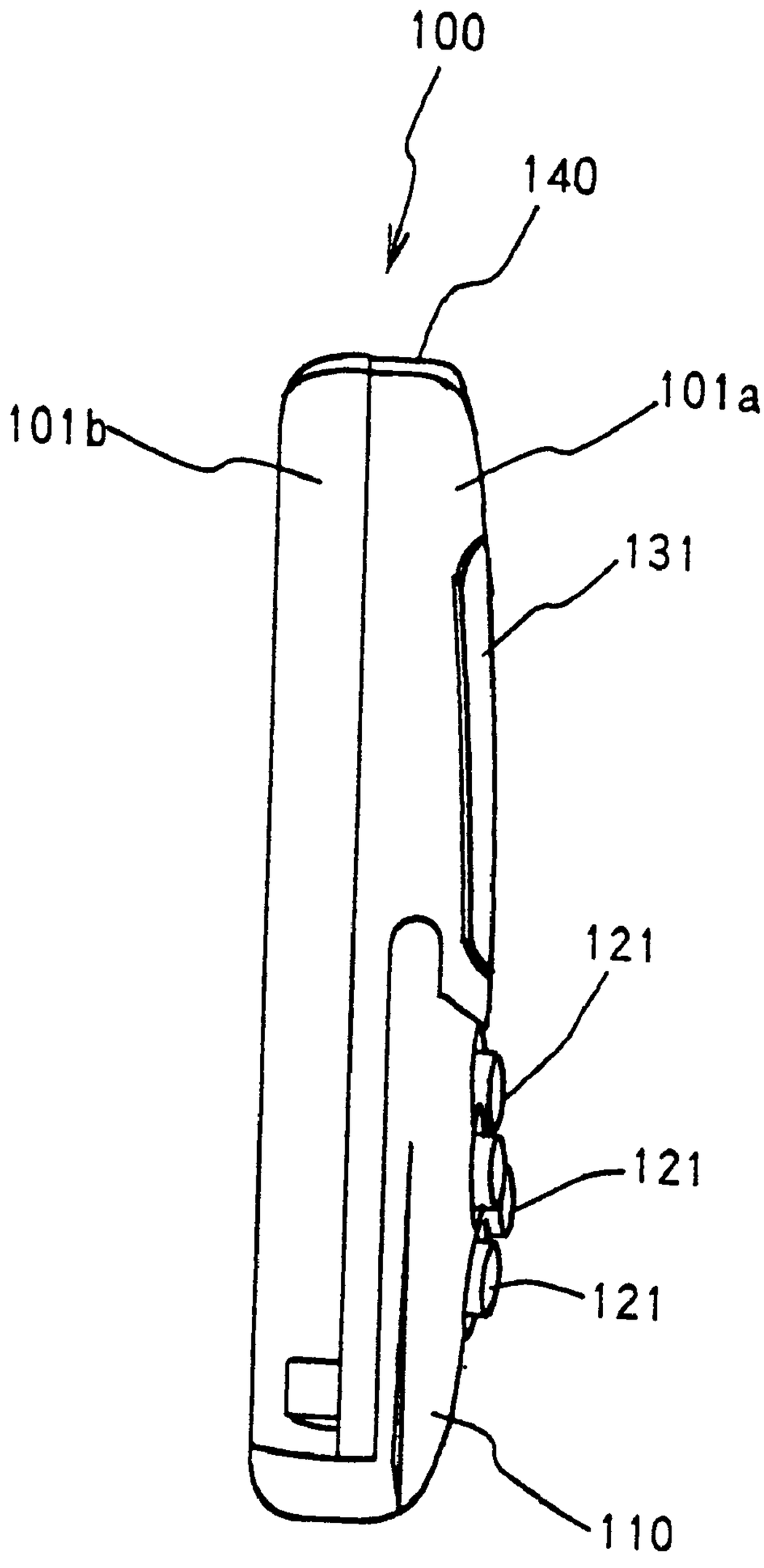


FIG. 16C





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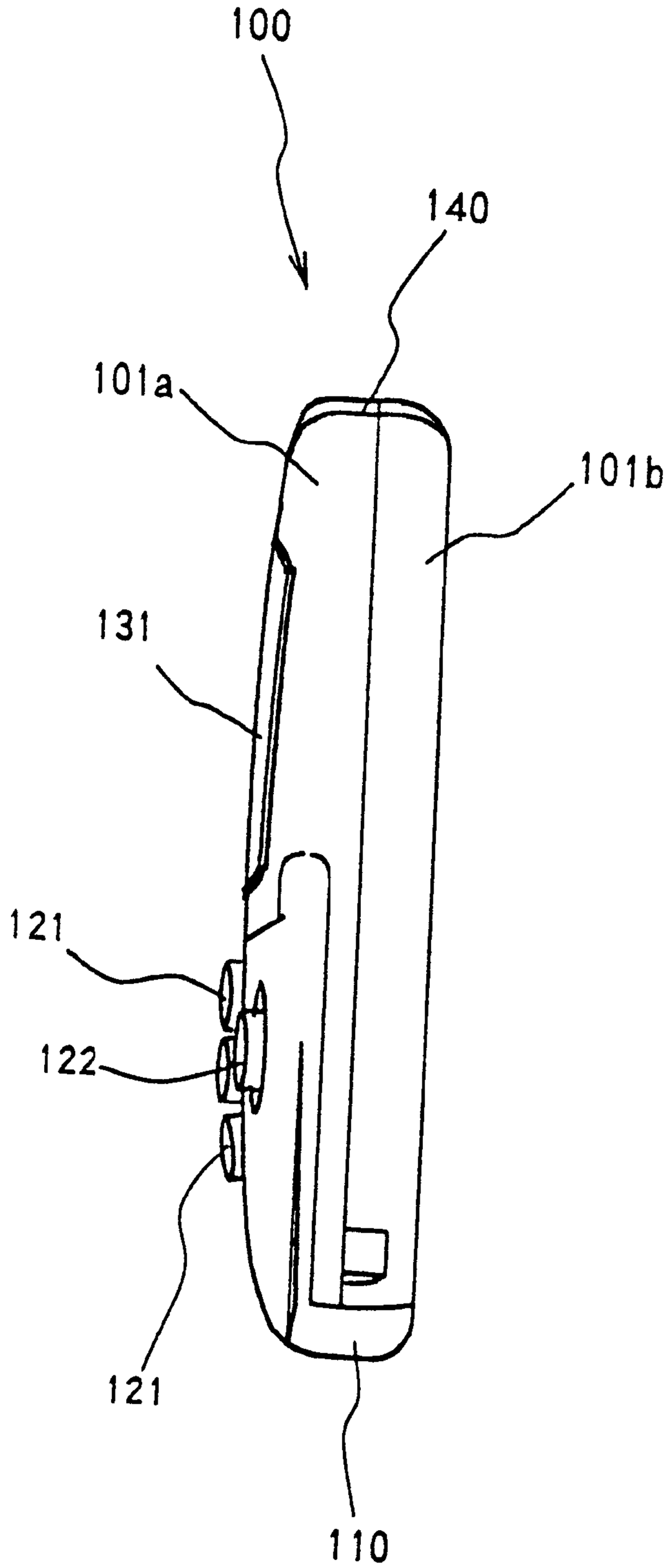

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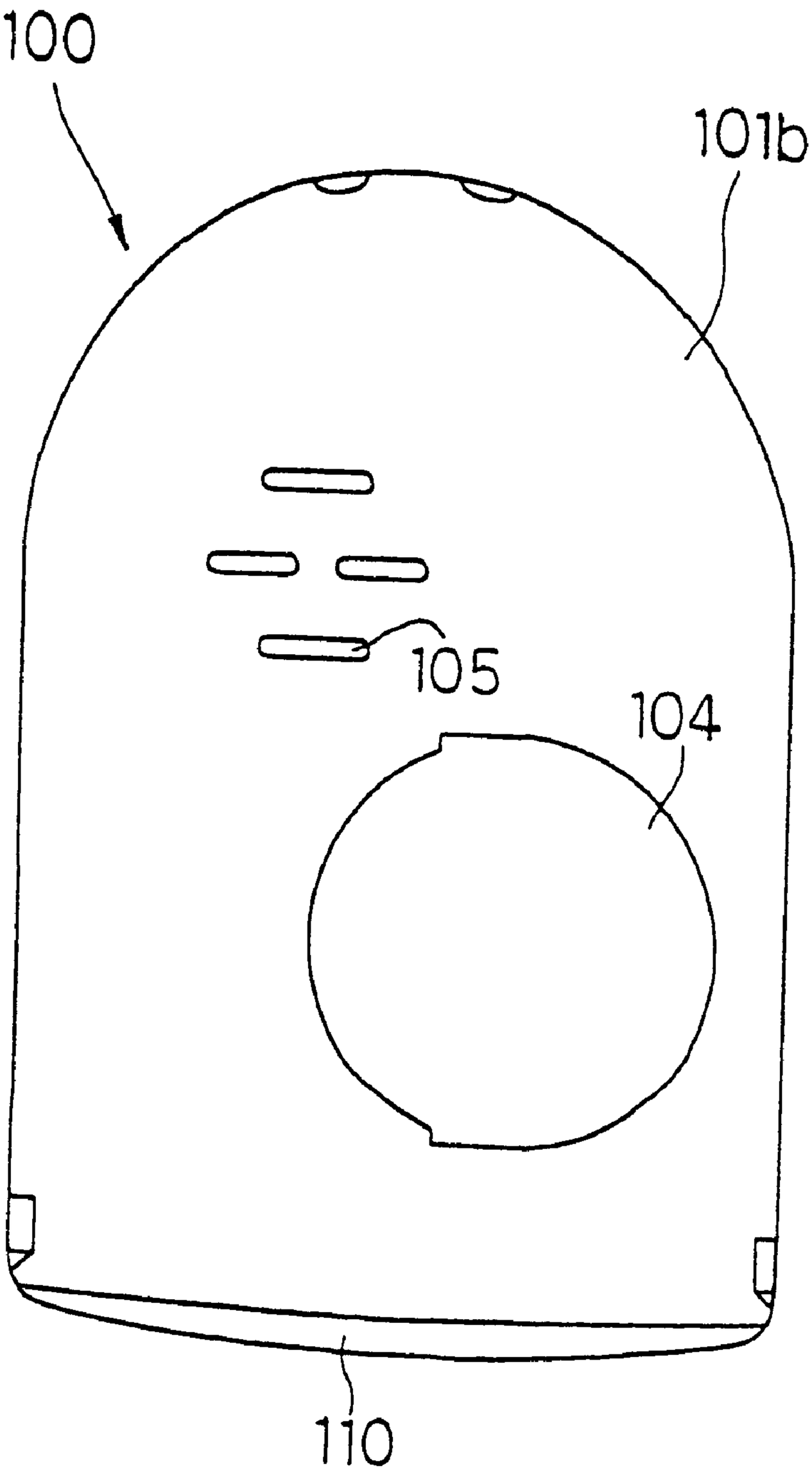

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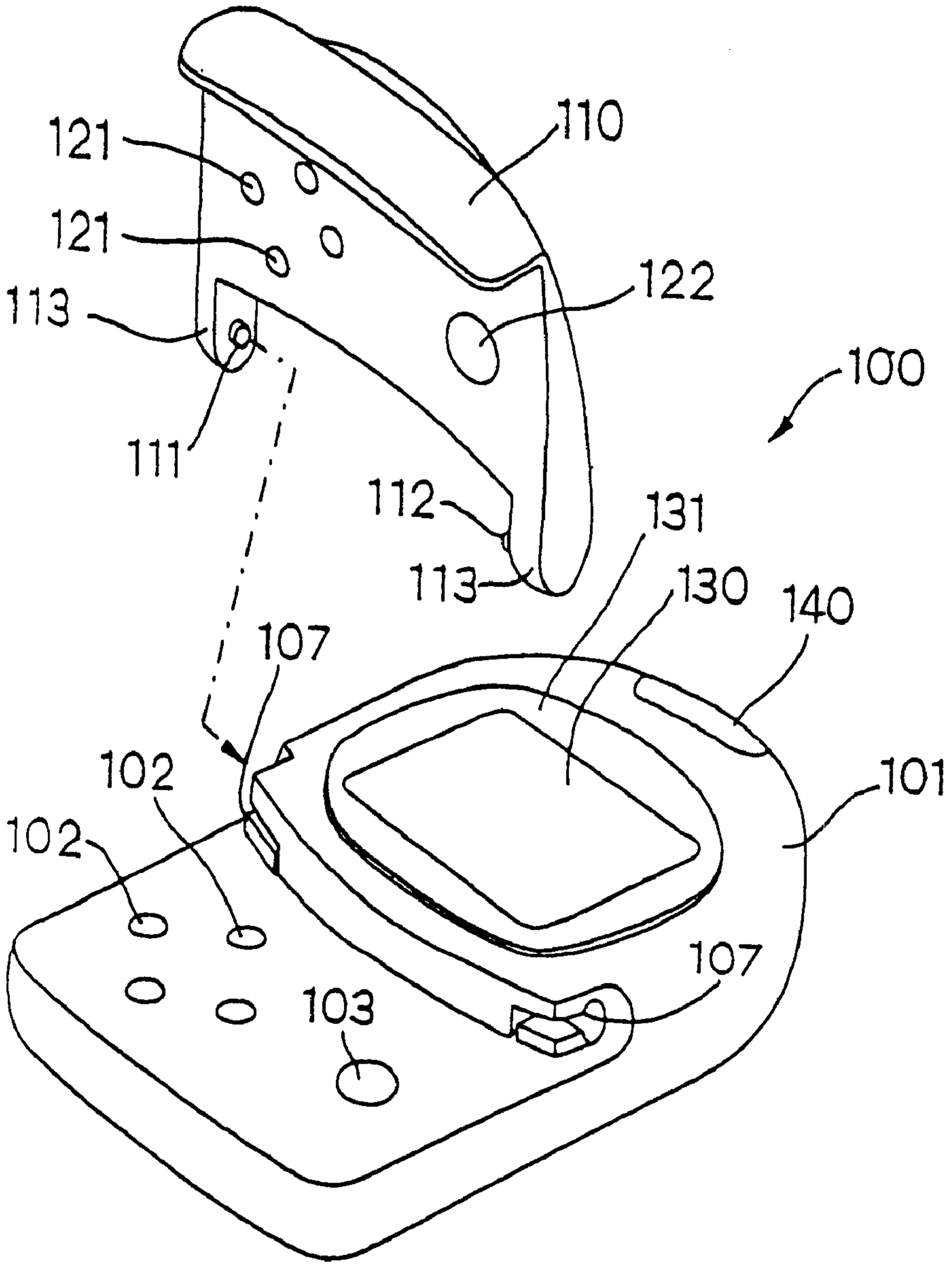
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FIG. 20

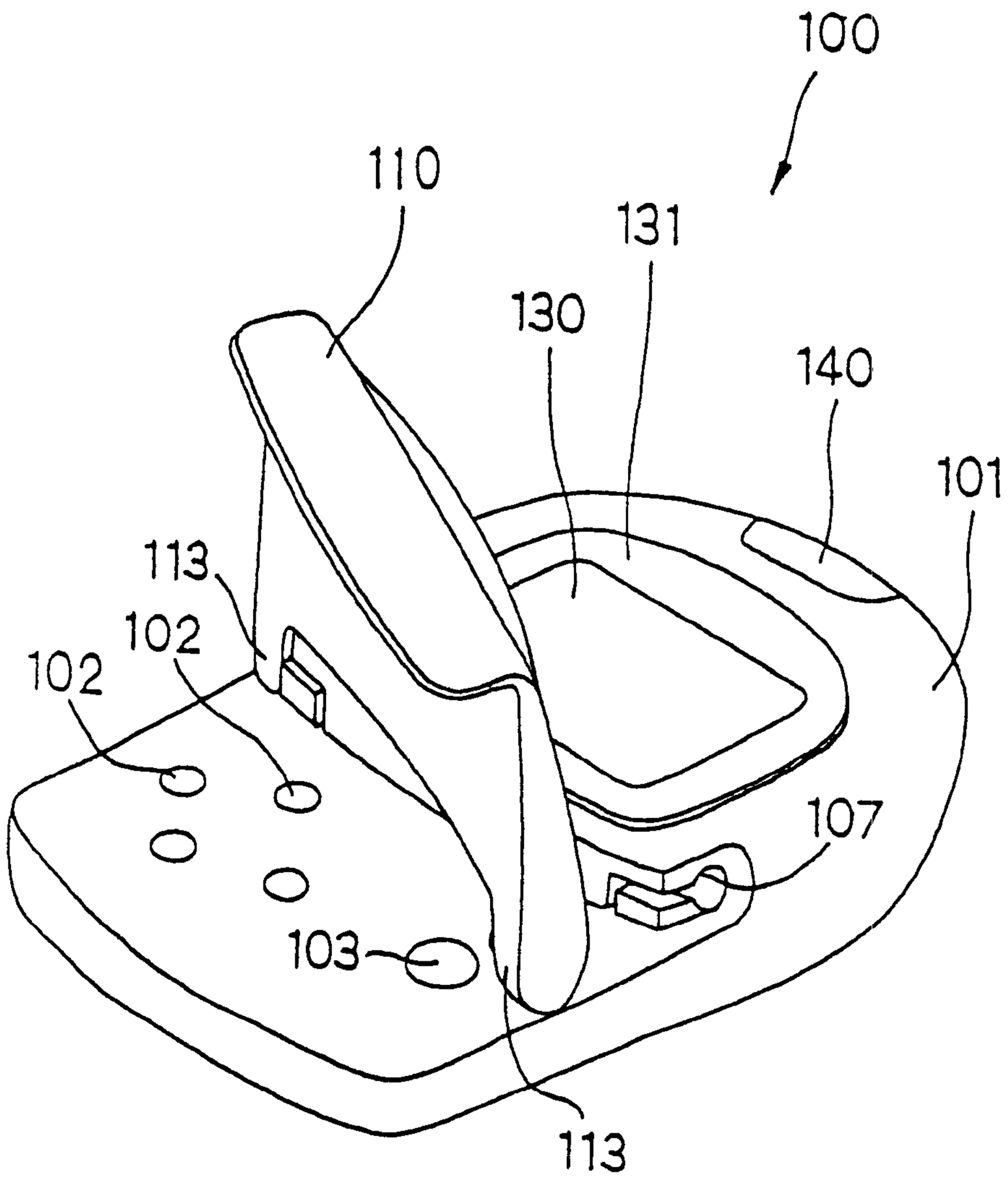
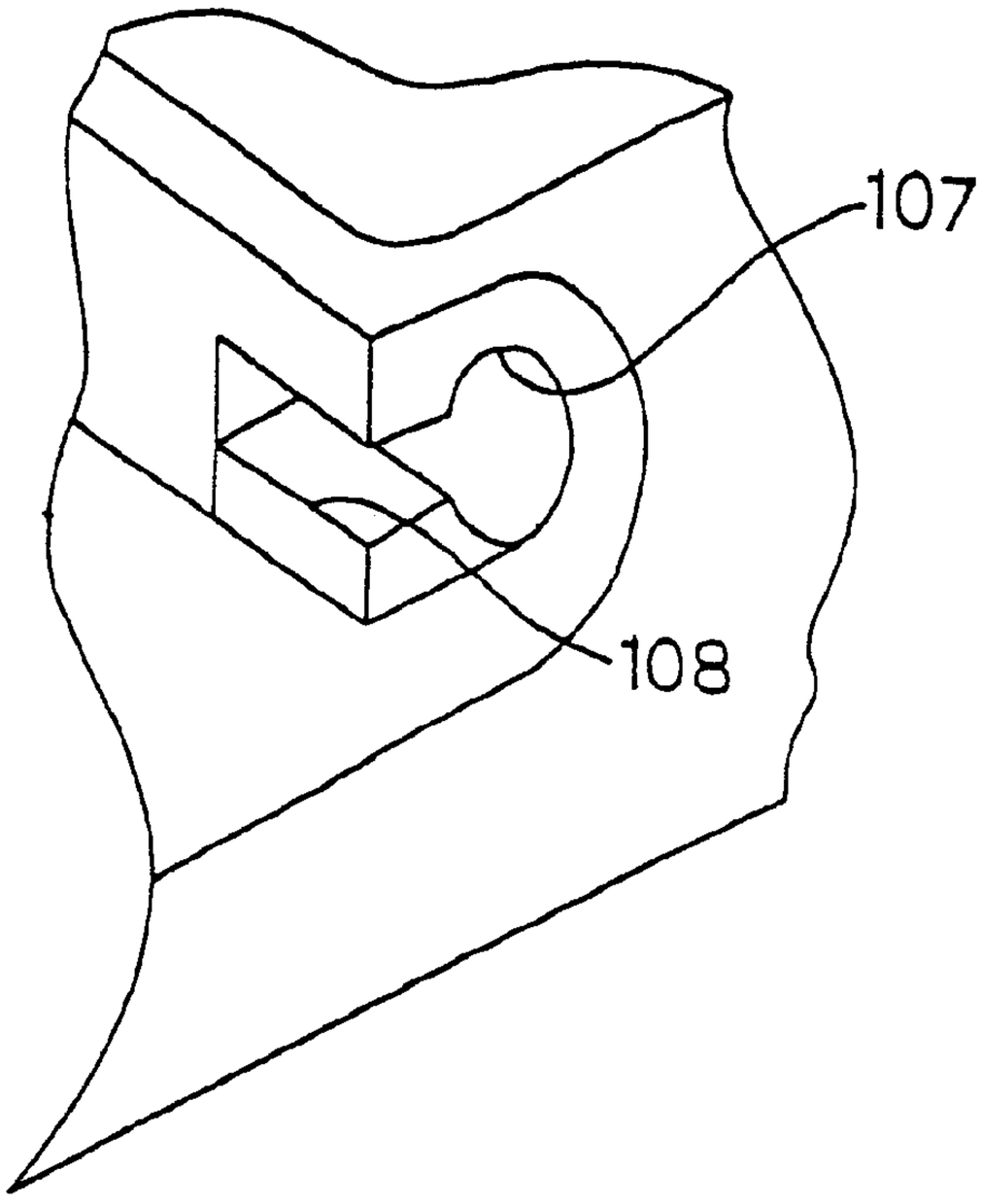


FIG. 21

FIG. 22



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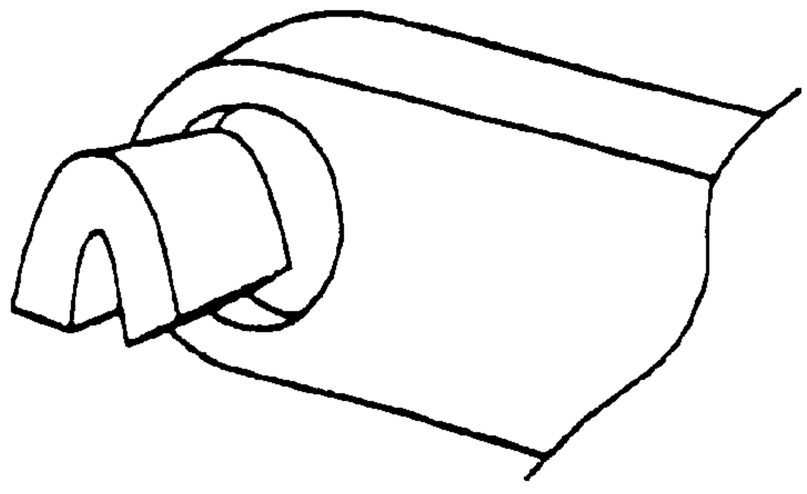

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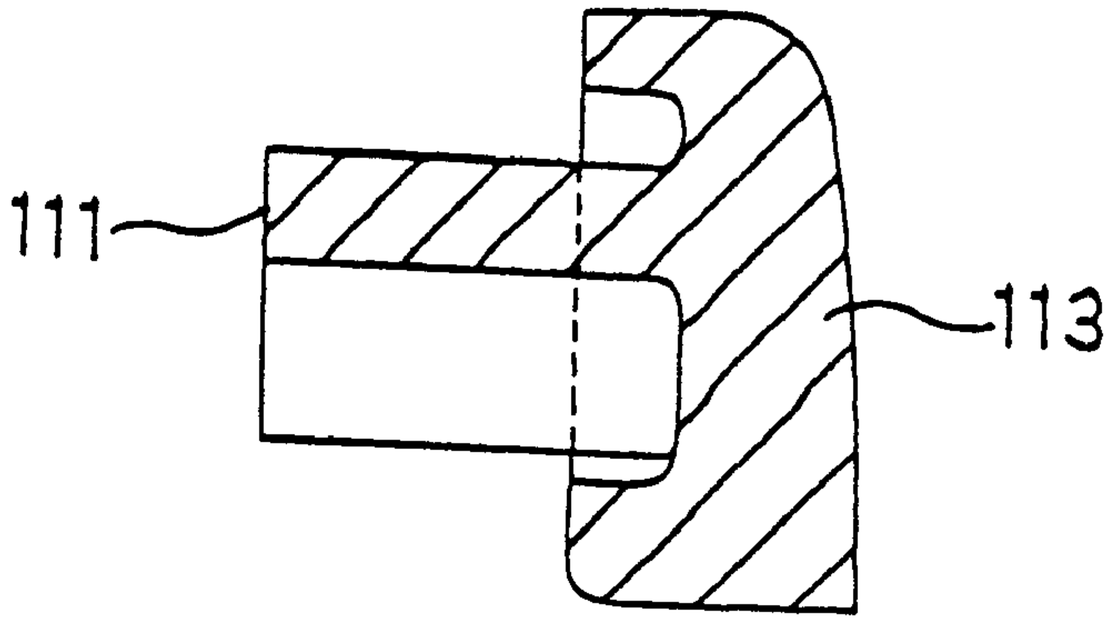

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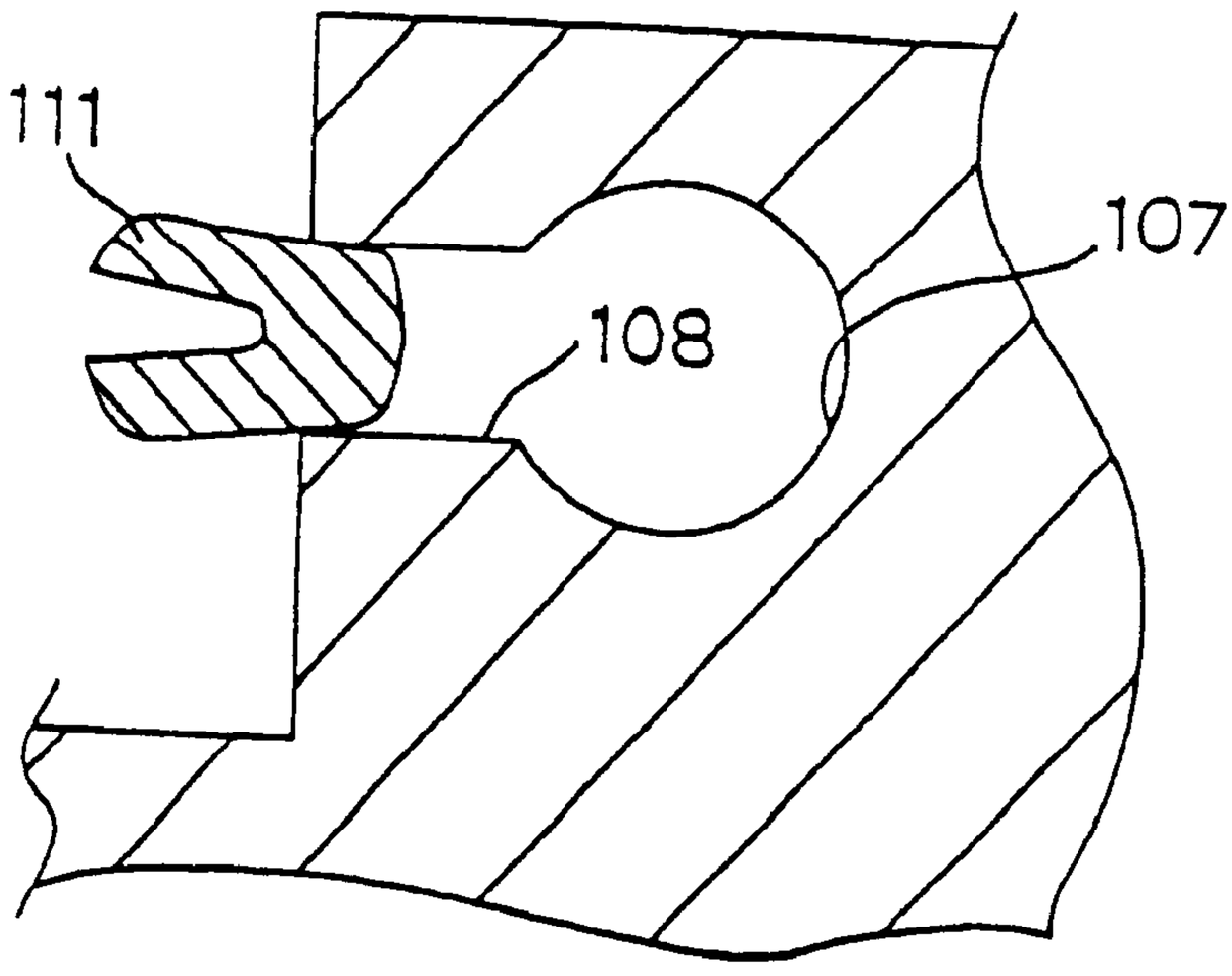


FIG. 26

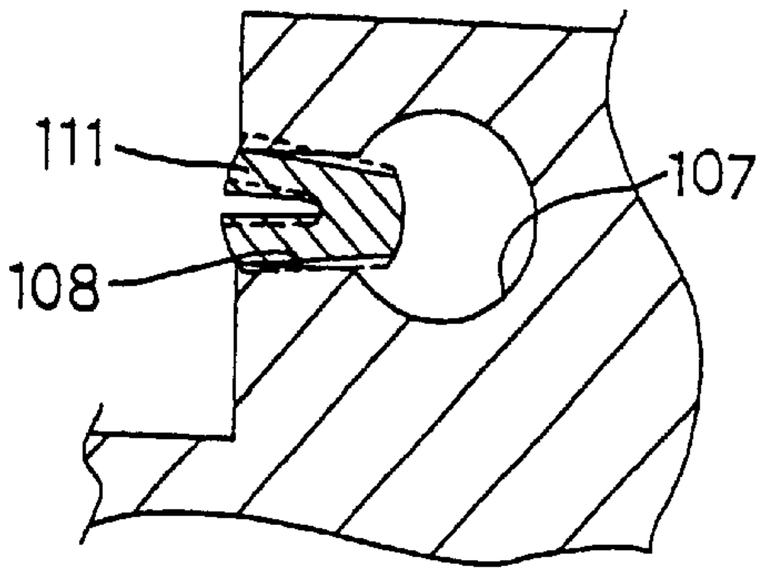
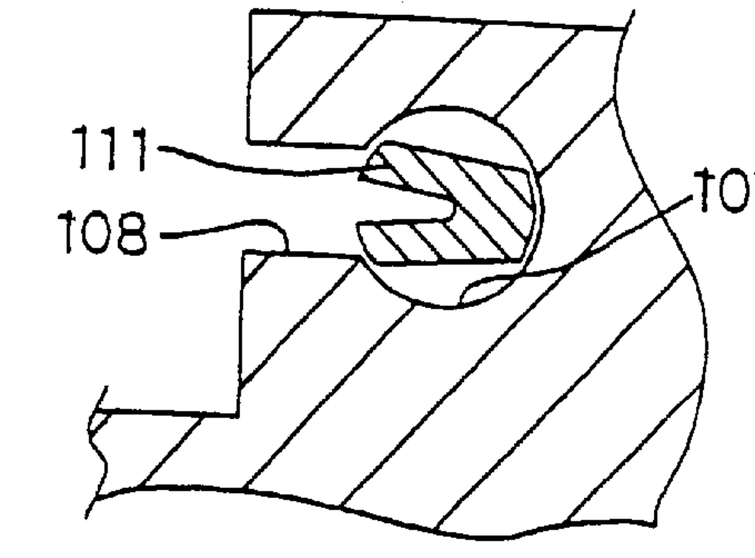


FIG. 27

FIG. 28



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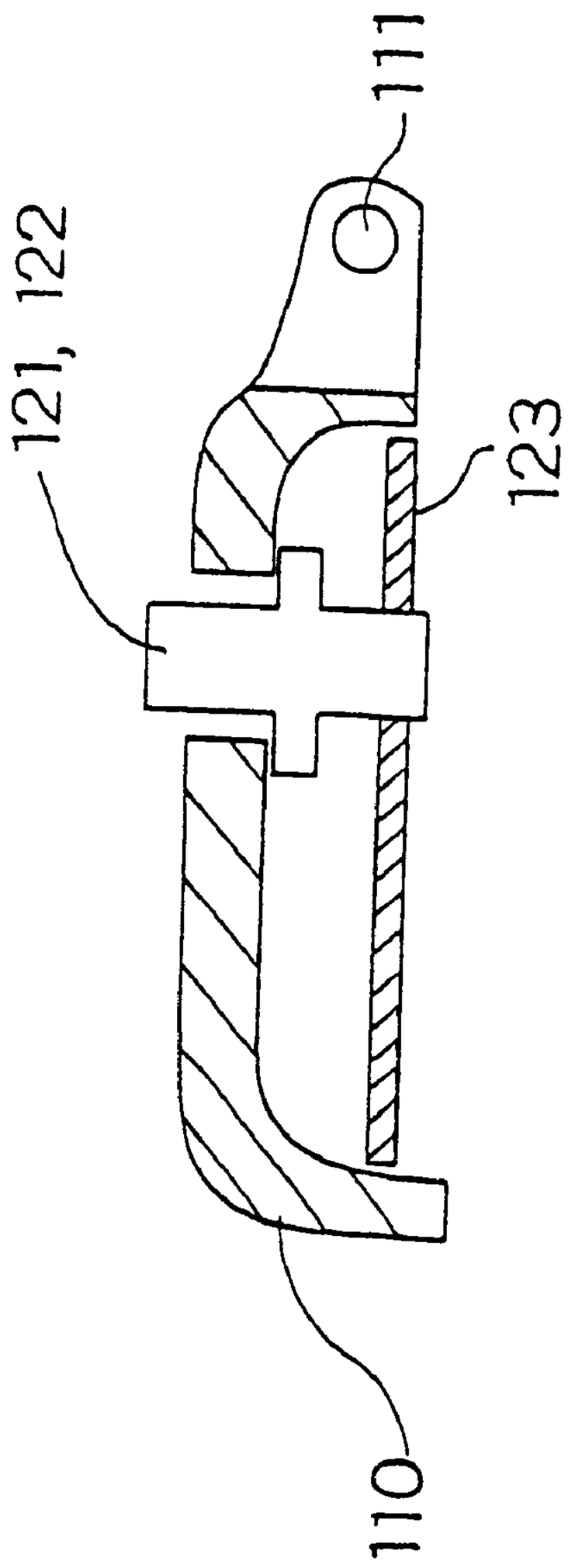

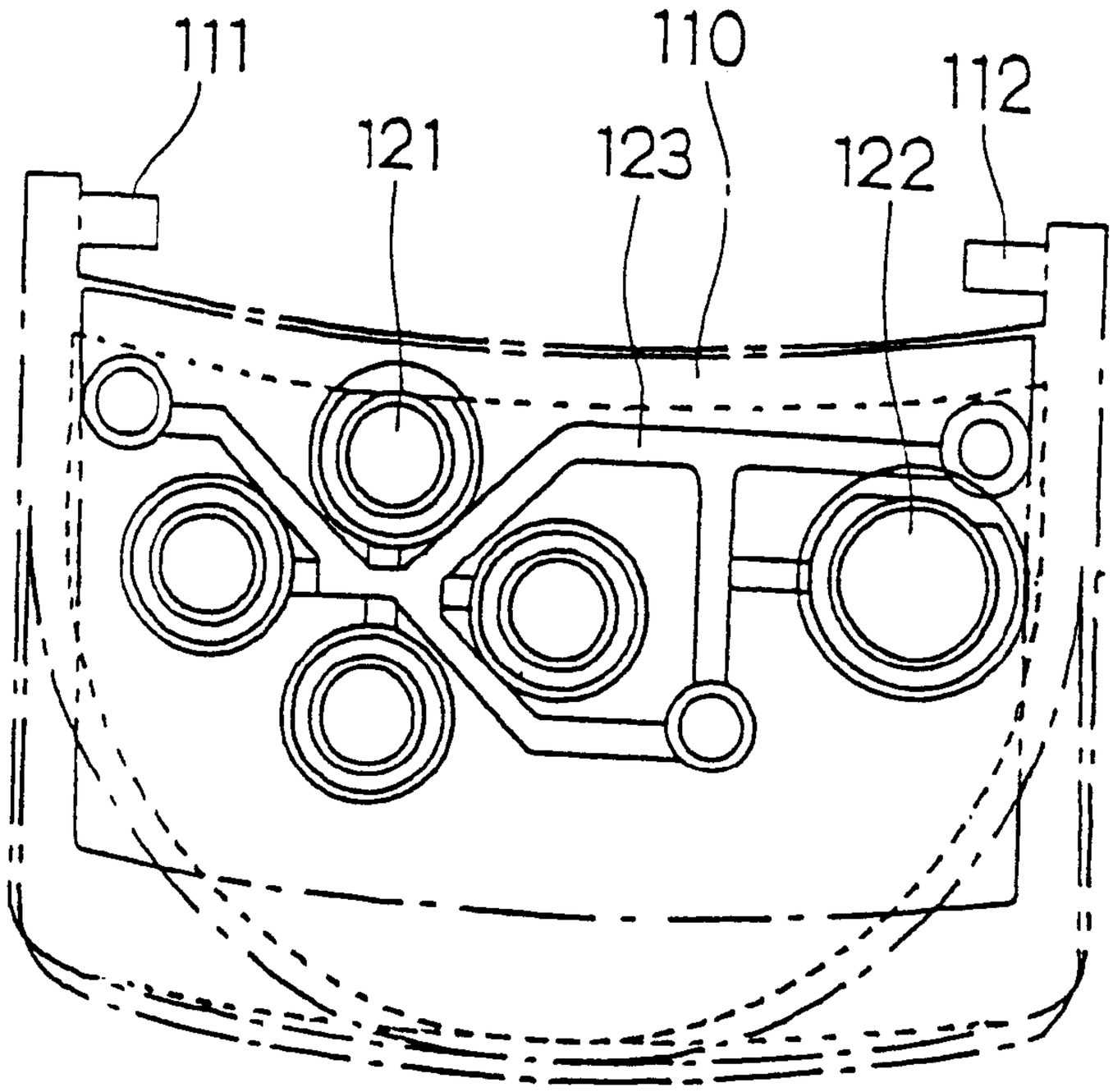

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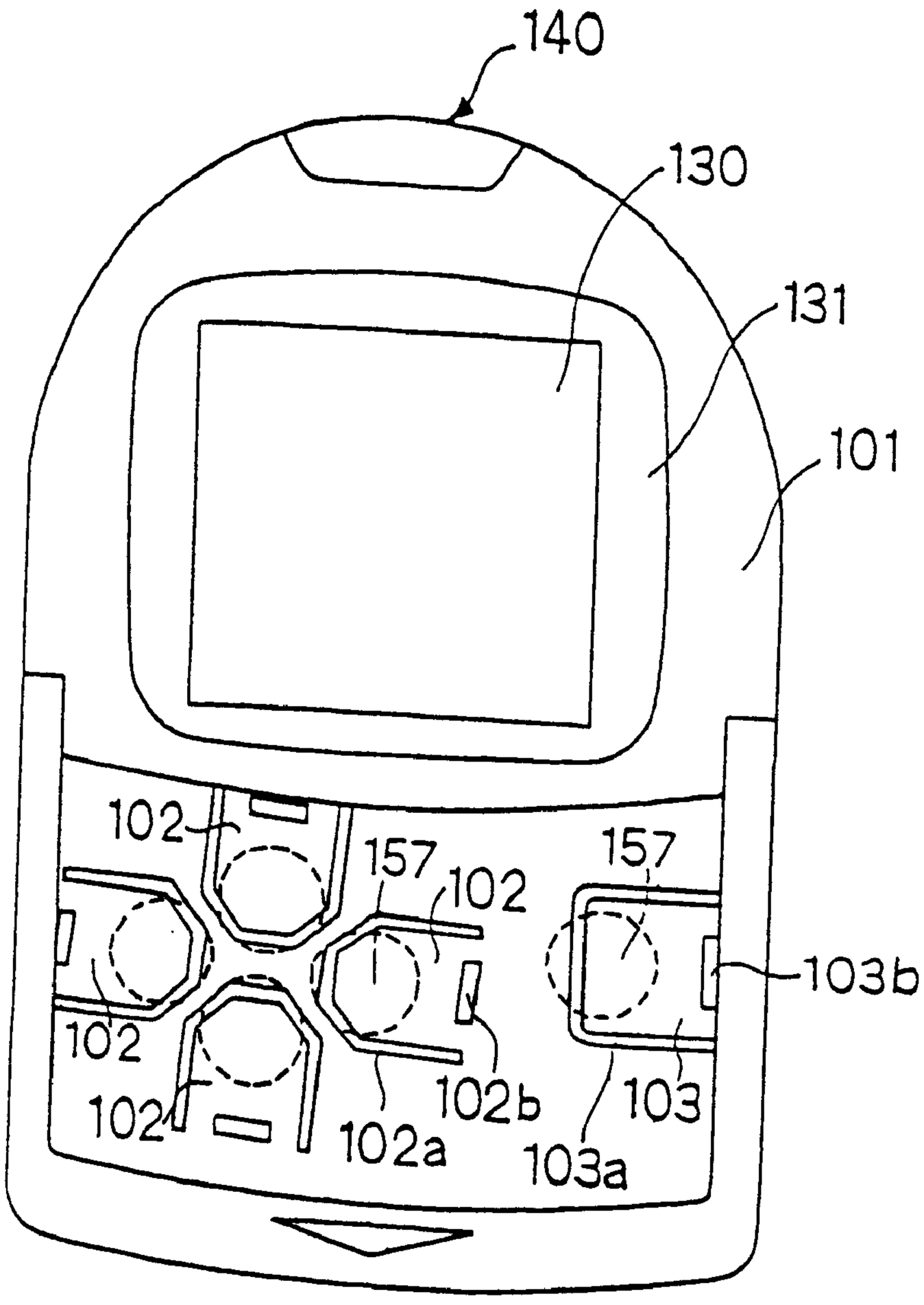
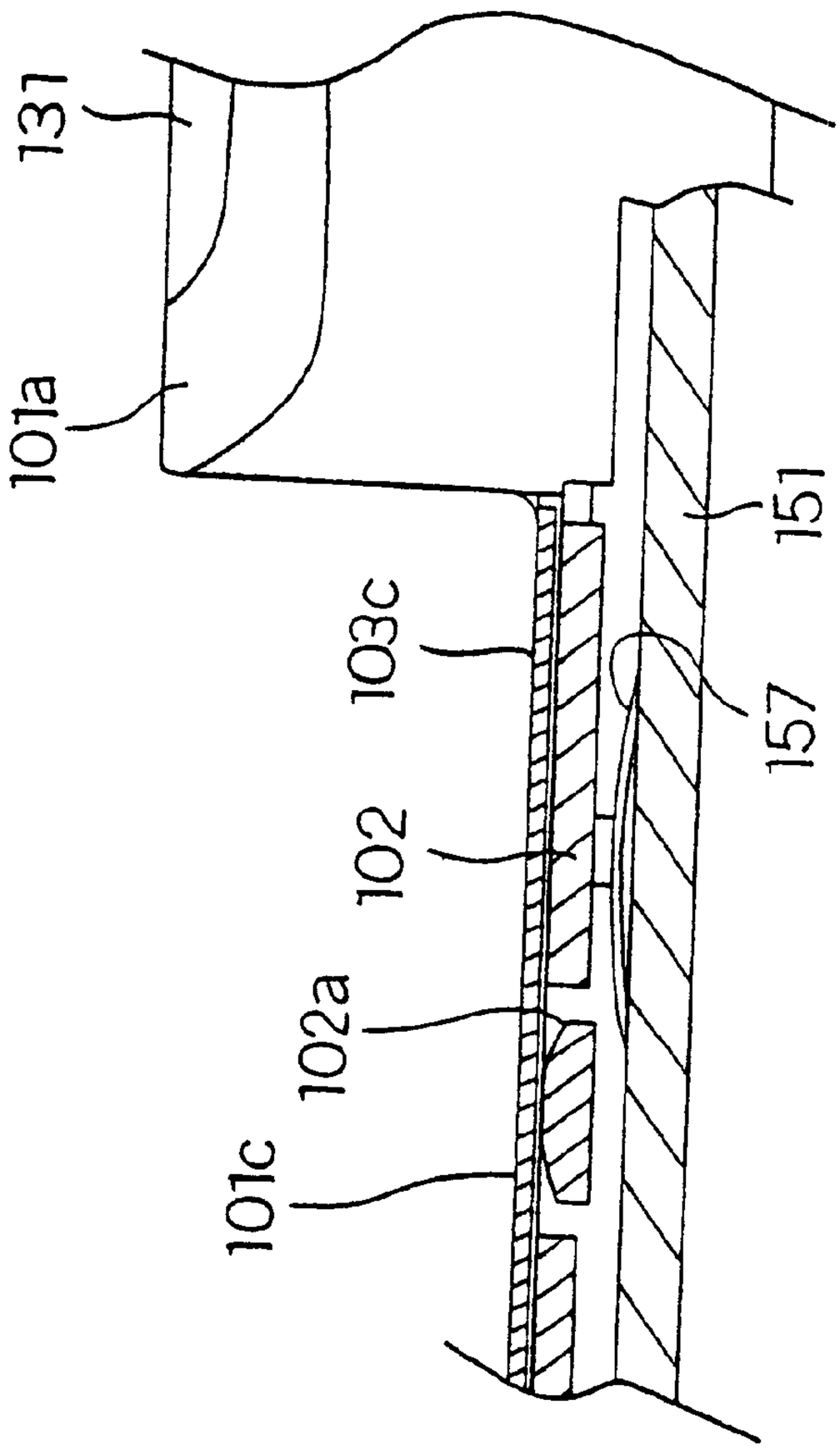


FIG. 31

FIG. 32



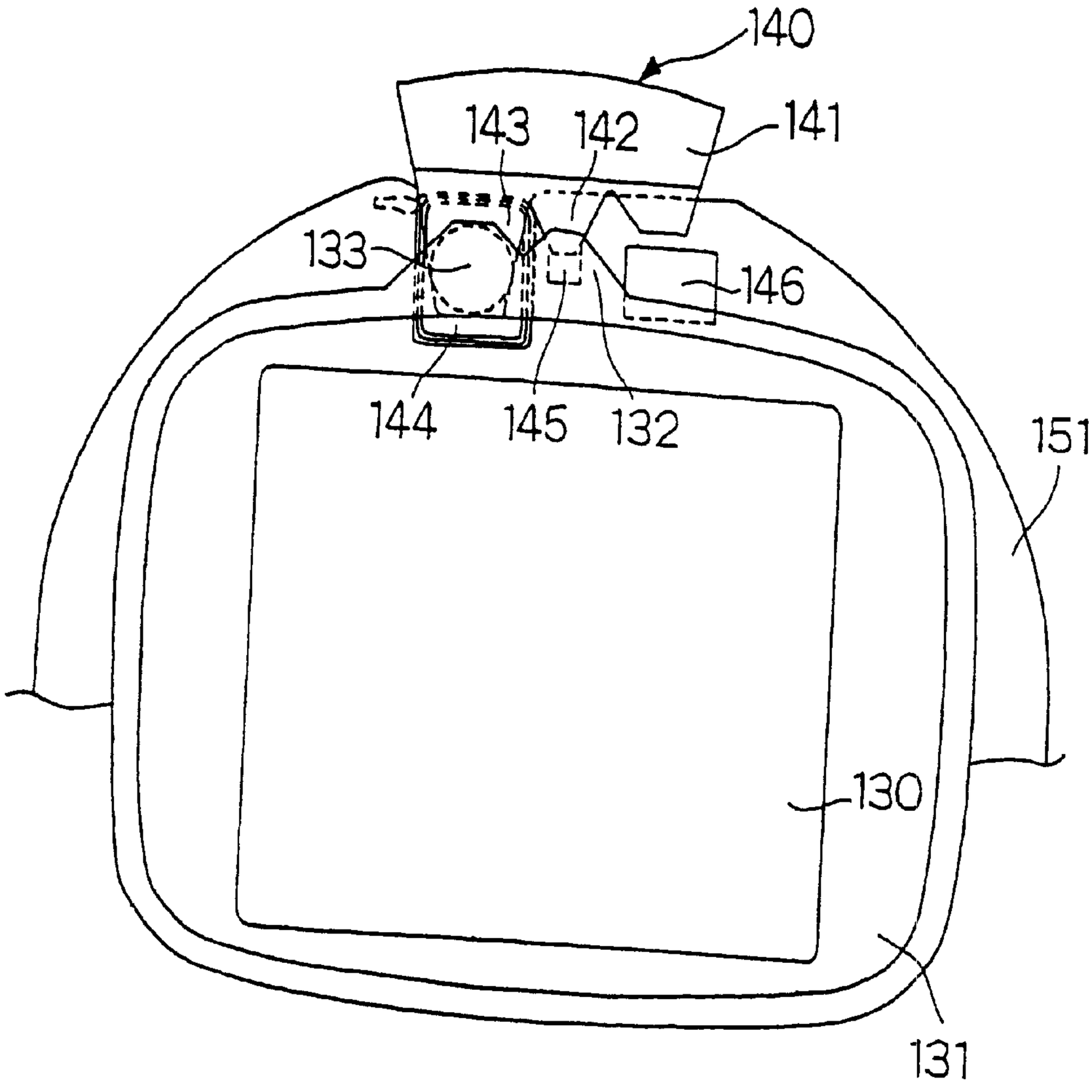


FIG. 33

FIG. 34

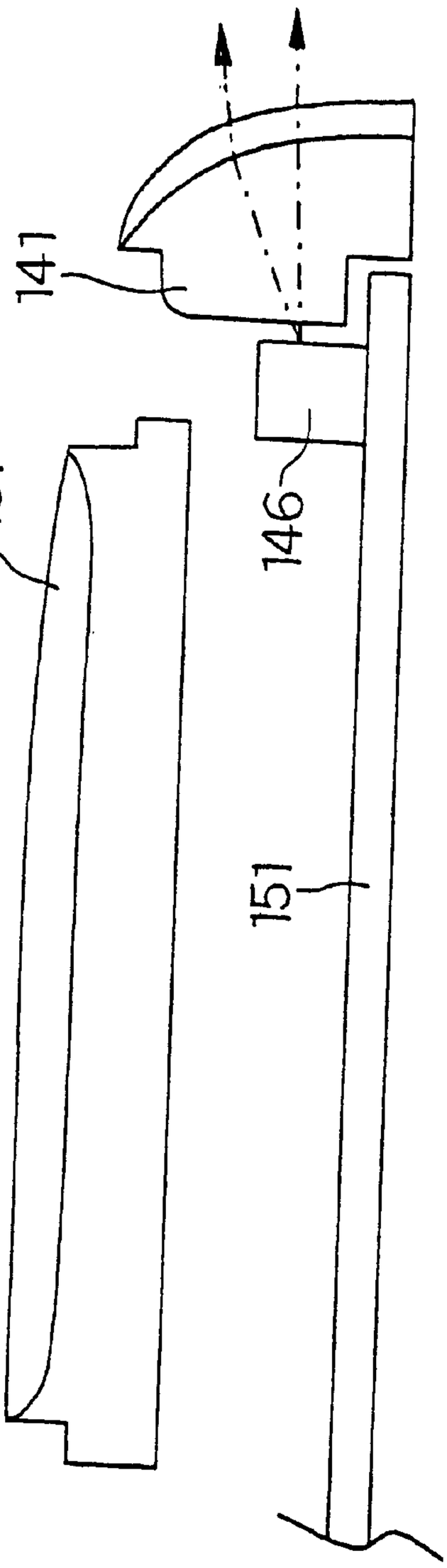
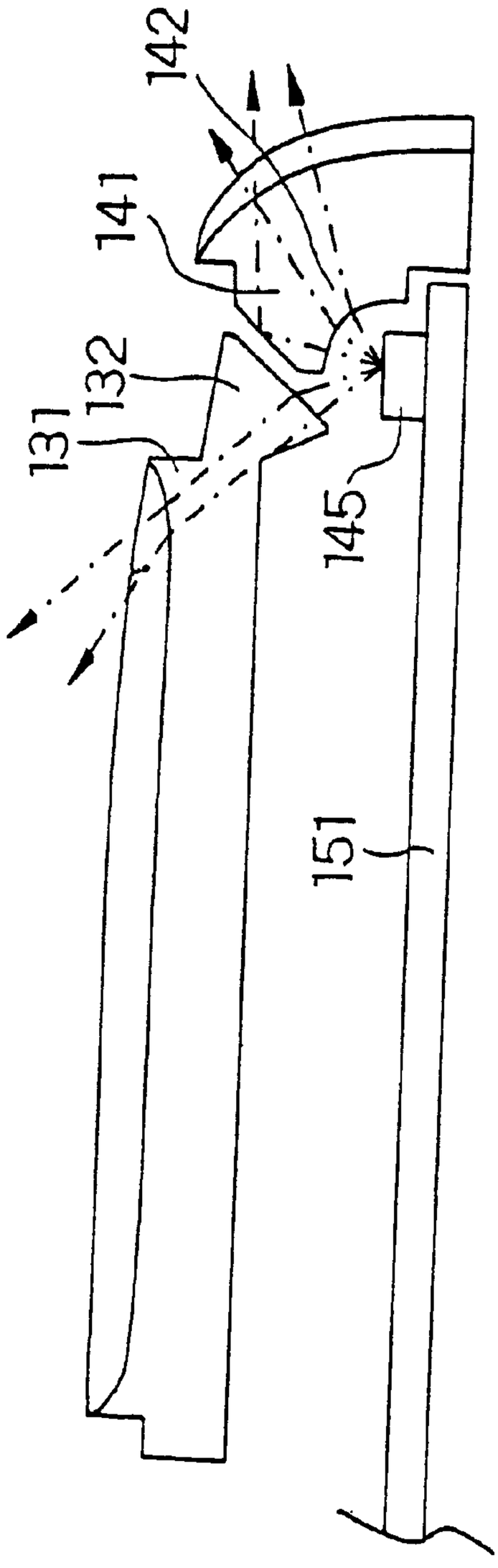


FIG. 35



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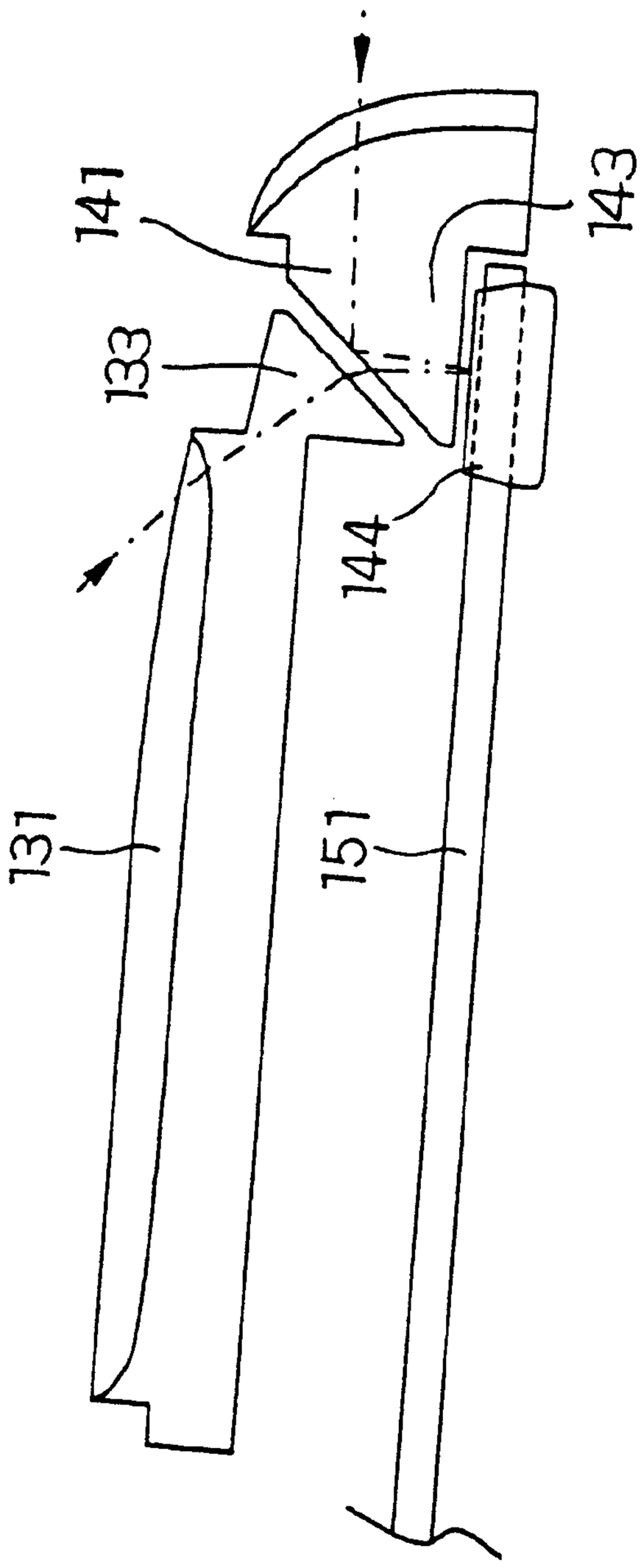


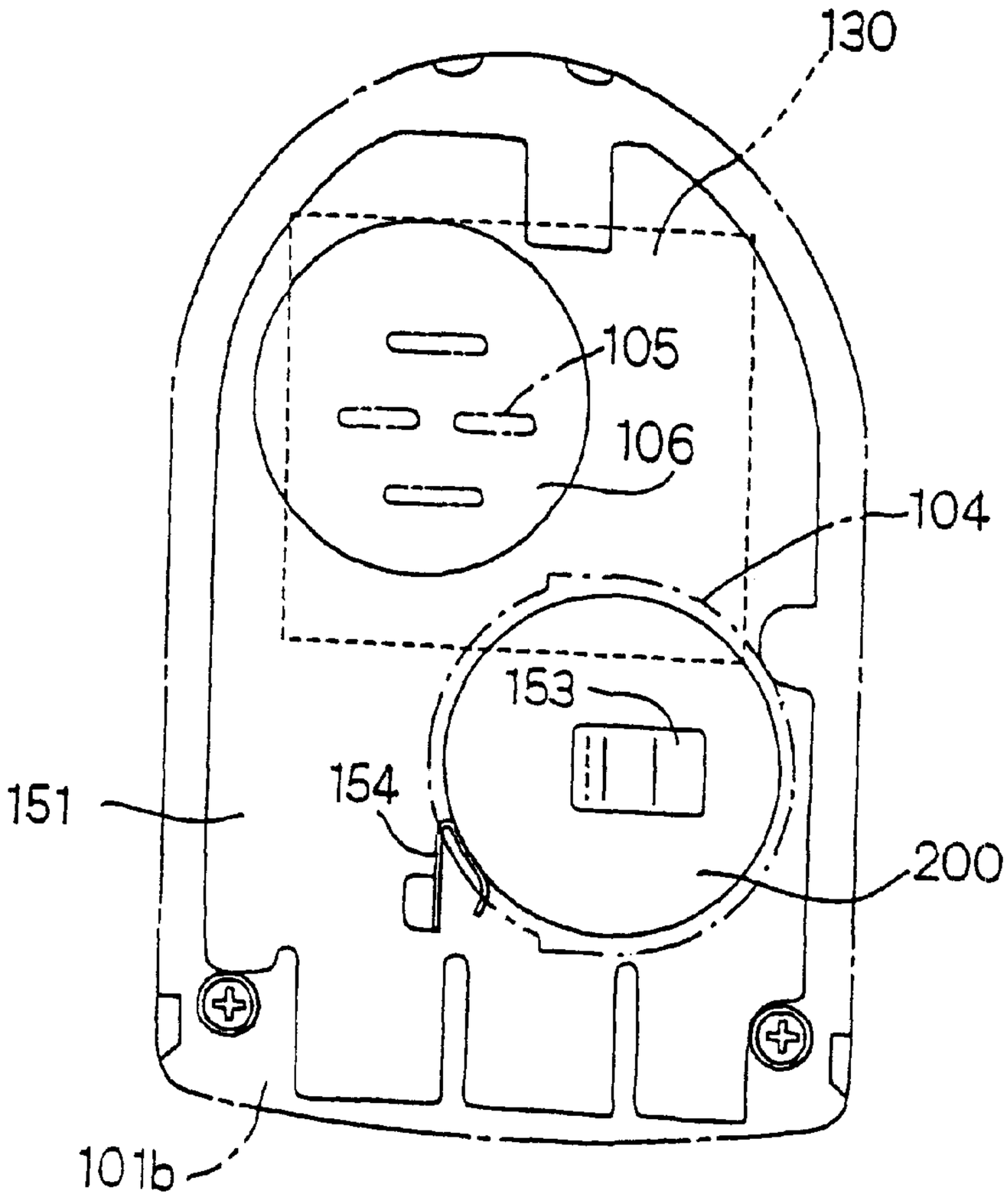


FIG. 37

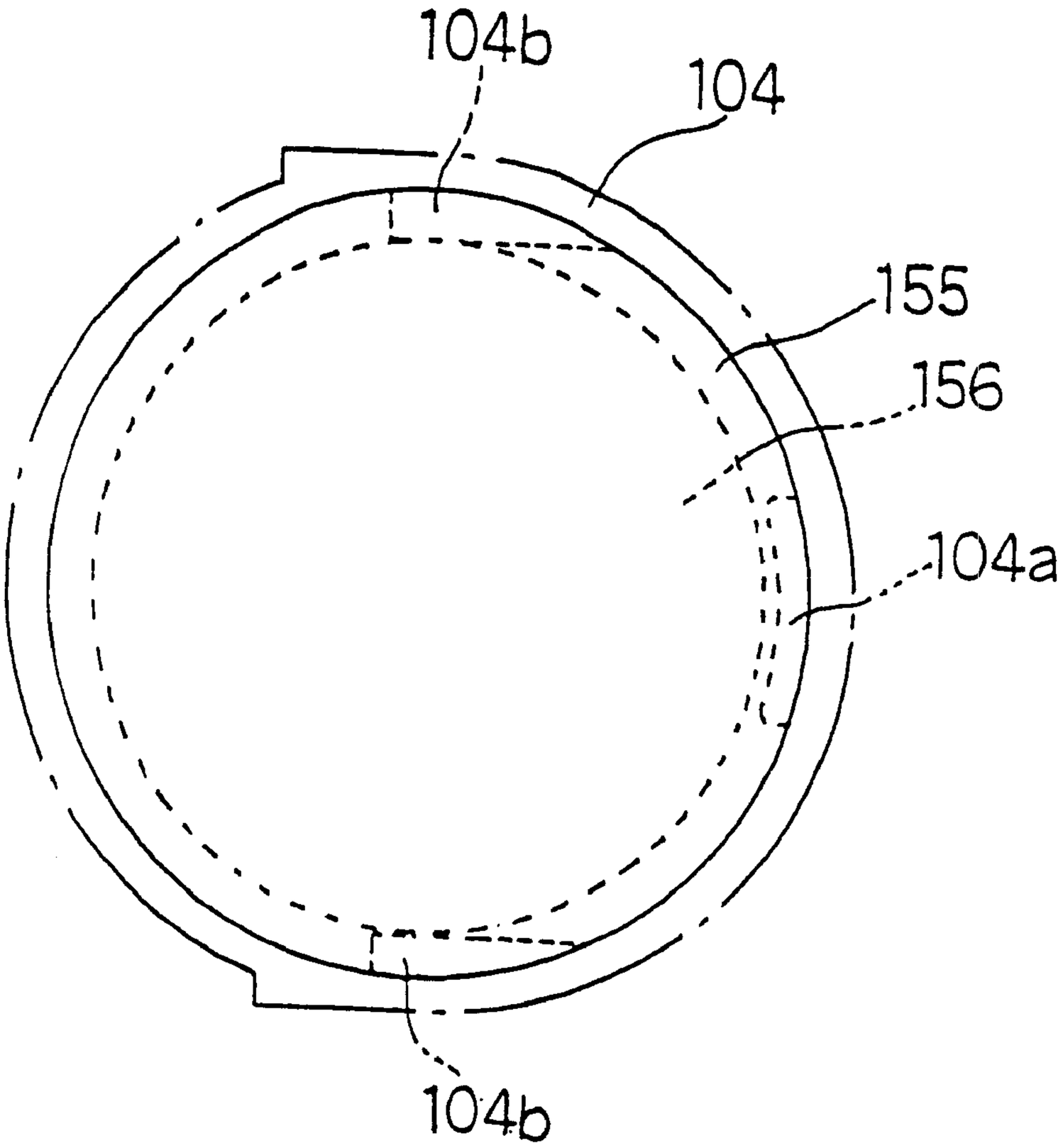


FIG. 38

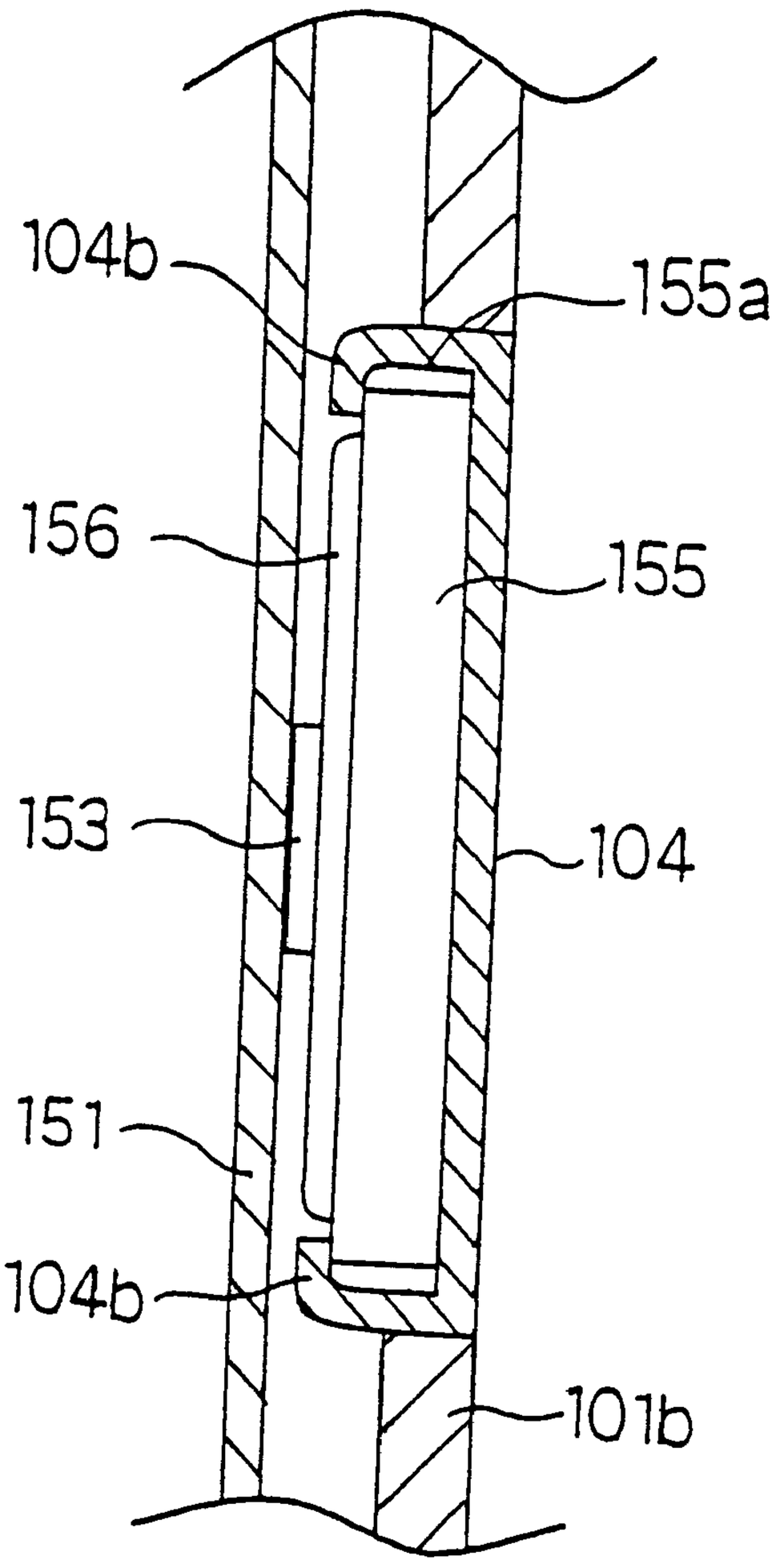


FIG. 39

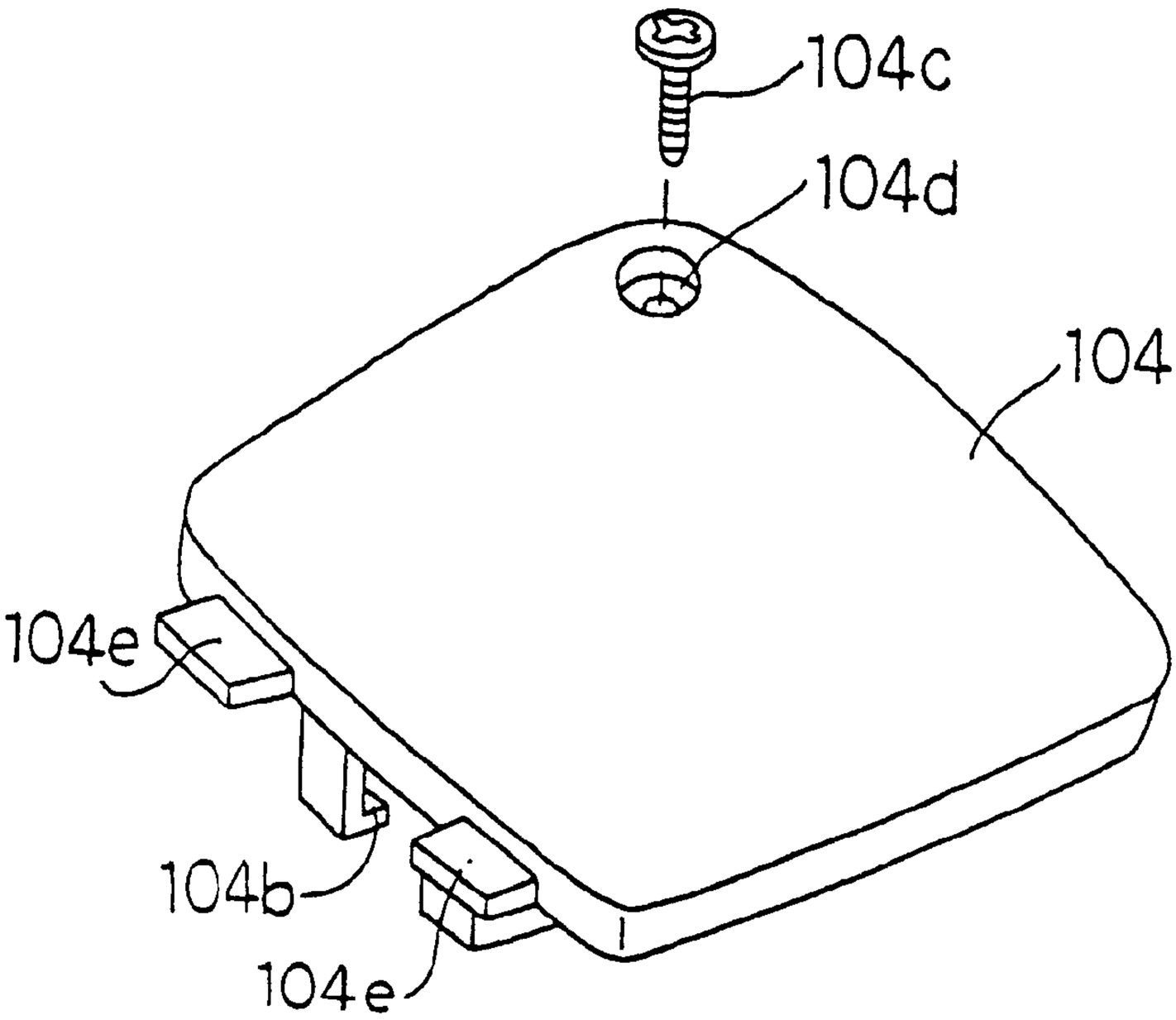


FIG. 40

FIG. 41

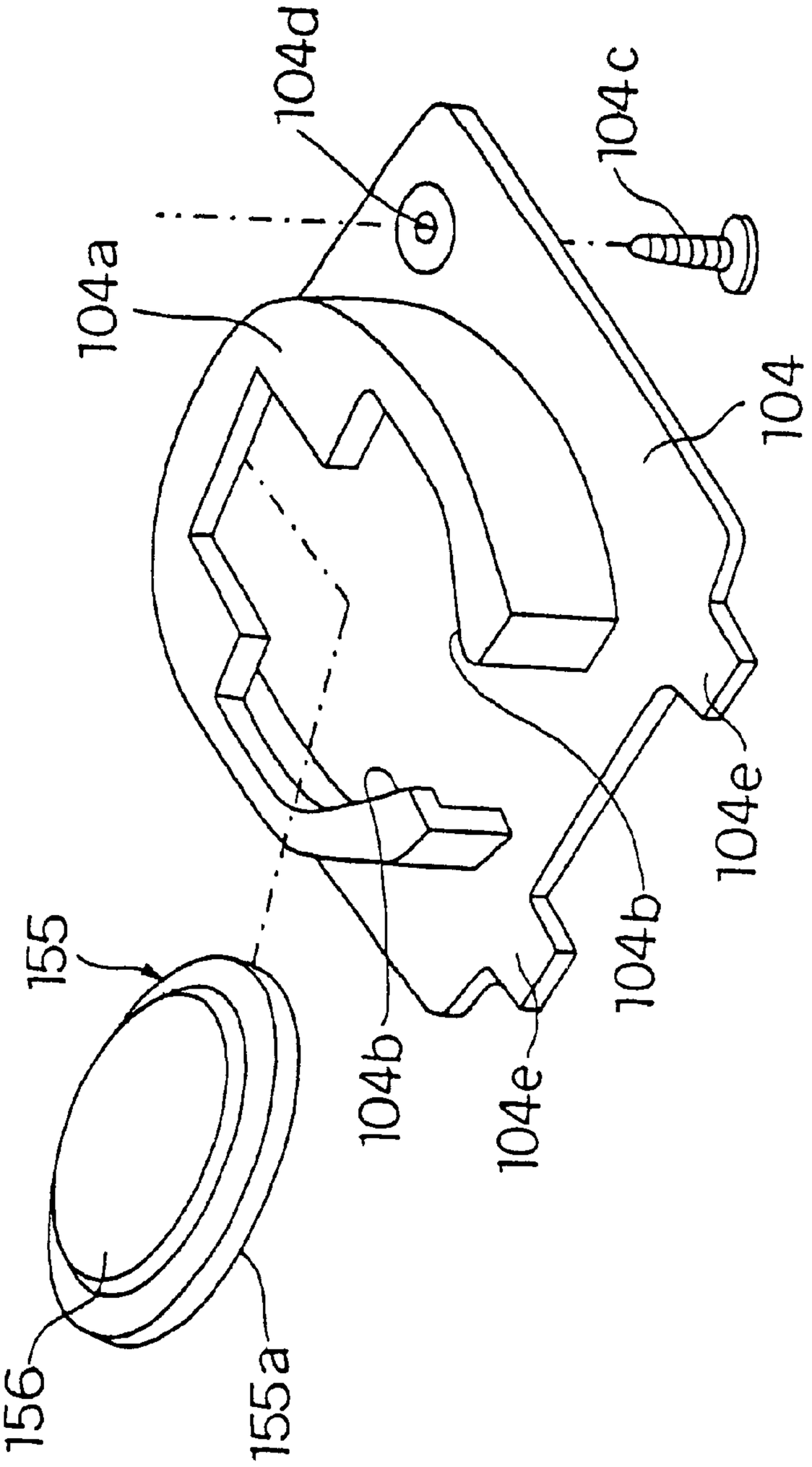


FIG. 42A

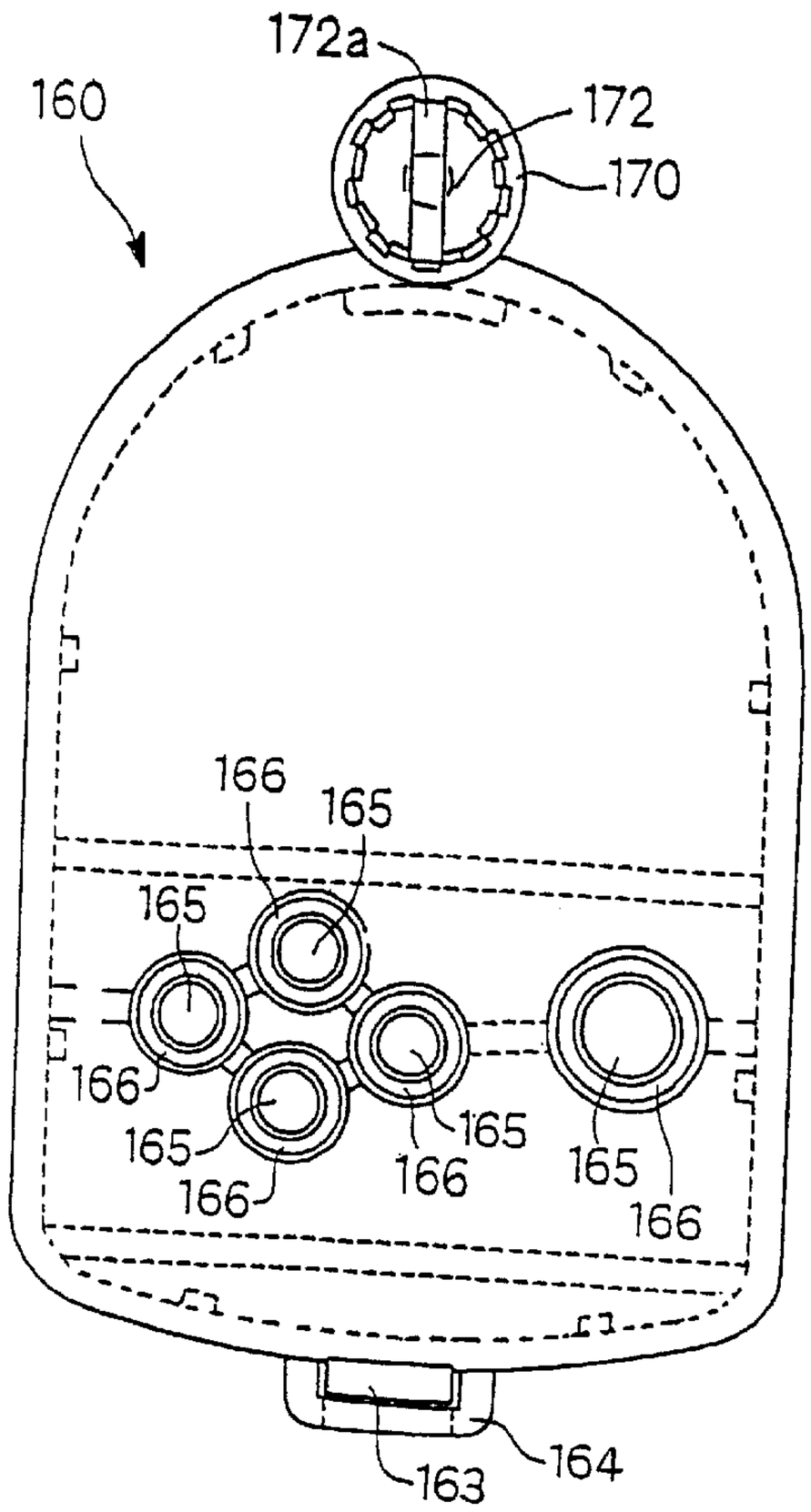
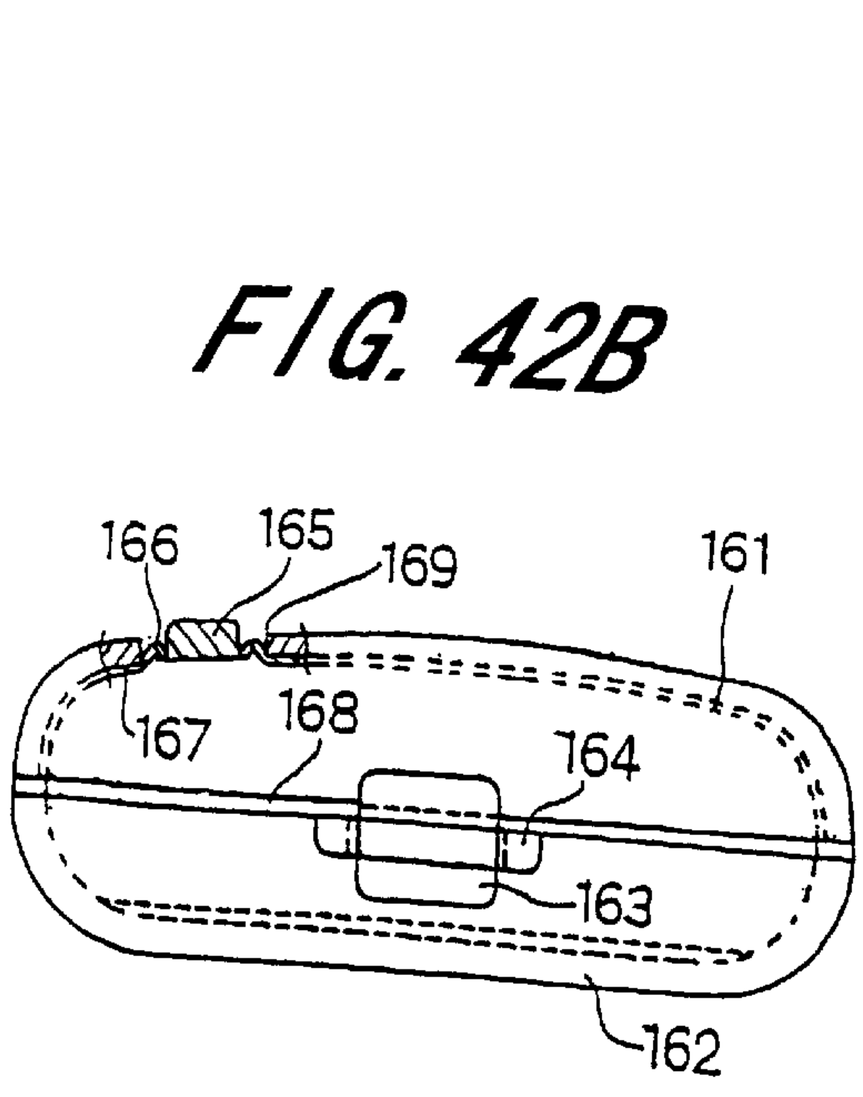


FIG. 42B



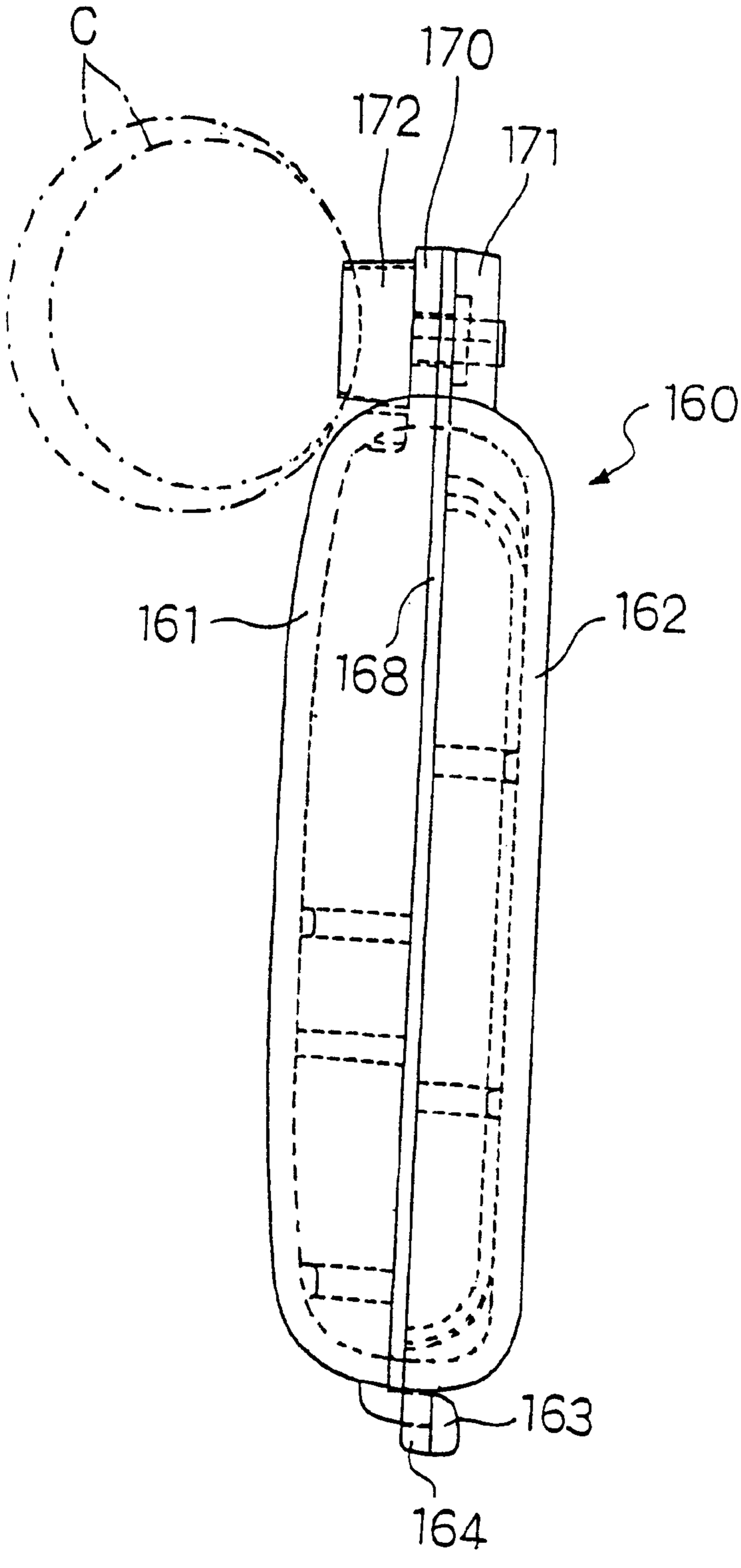


FIG. 43

FIG. 44A

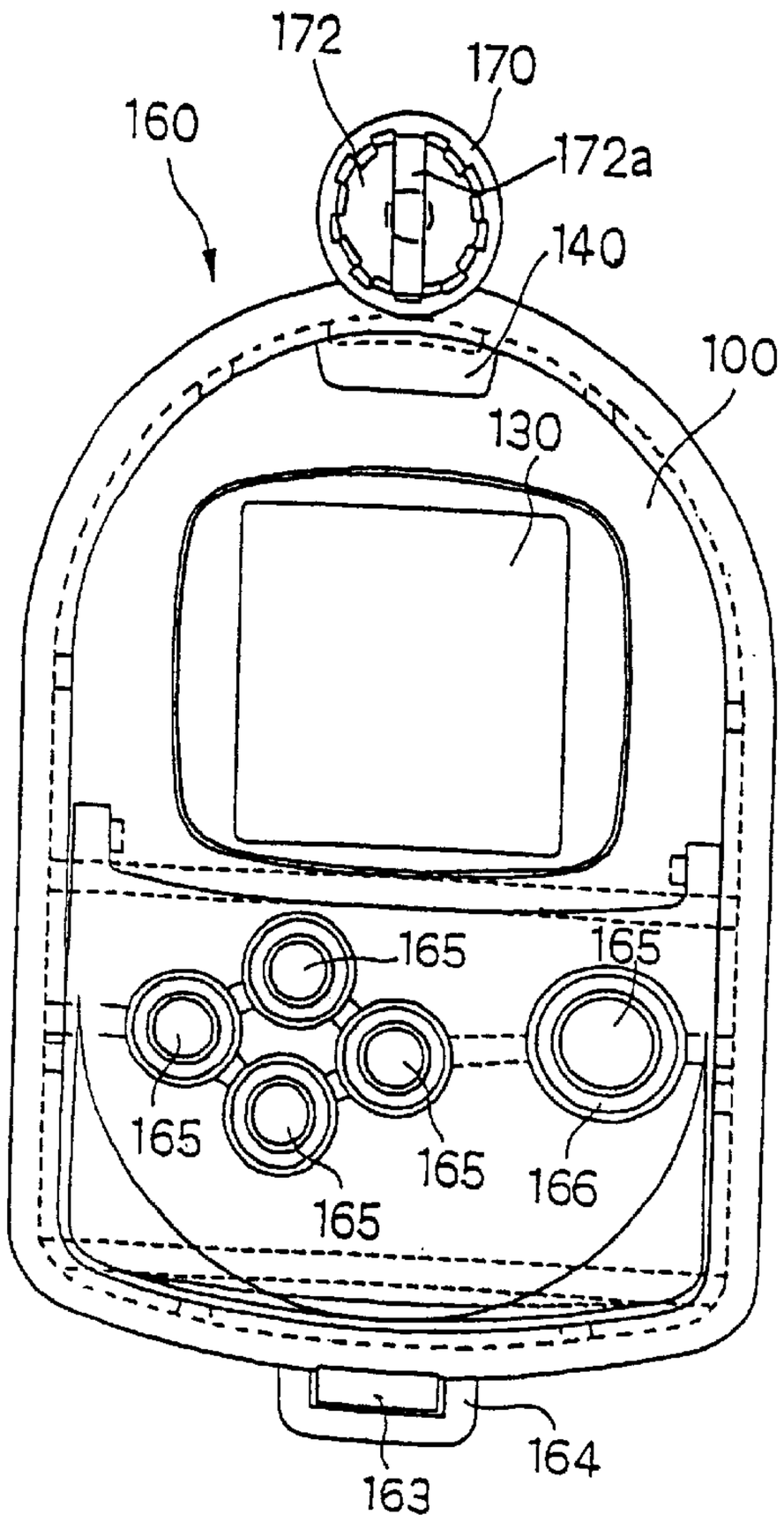
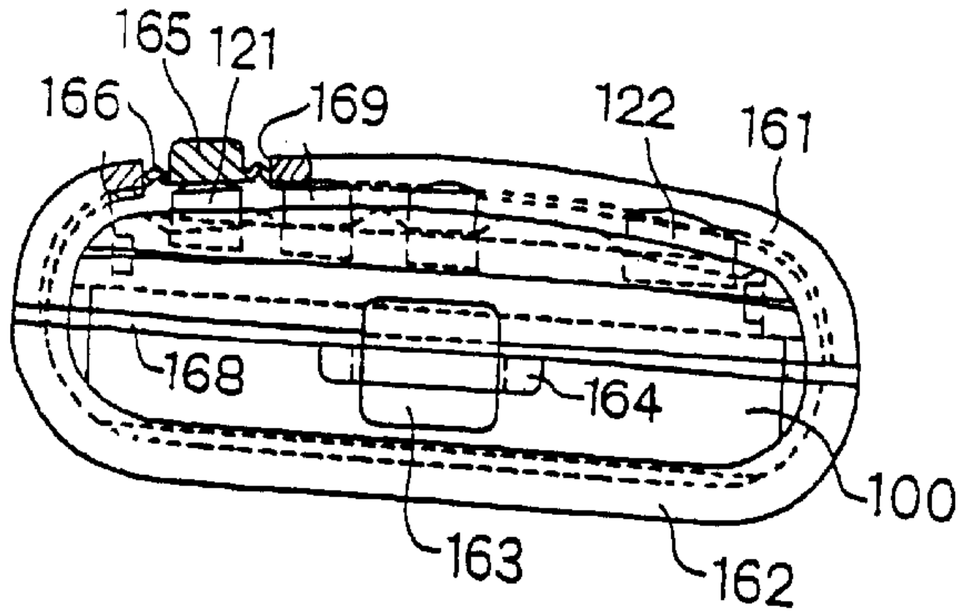


FIG. 44B



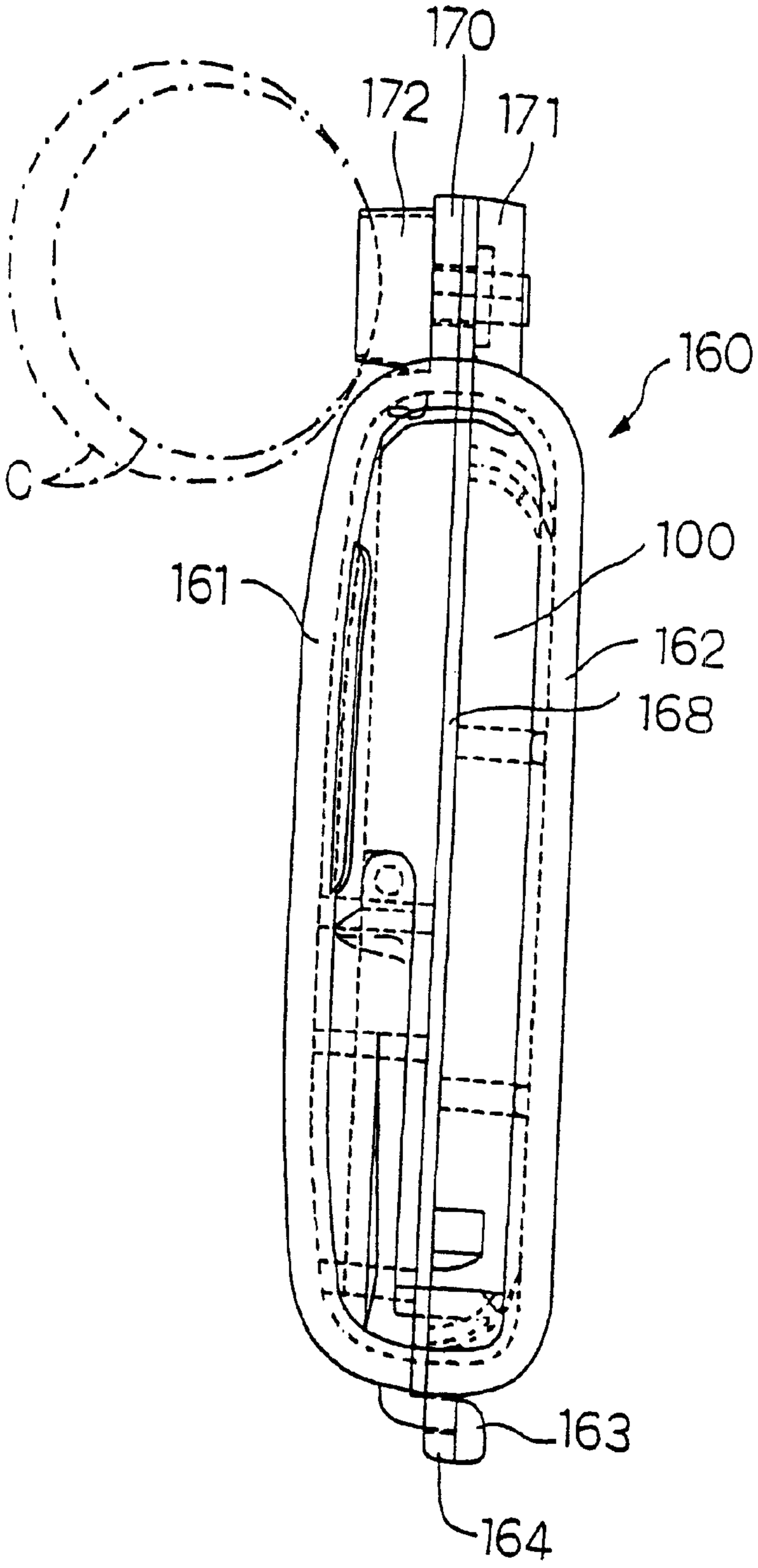


FIG. 45

FIG. 46A PRIOR ART

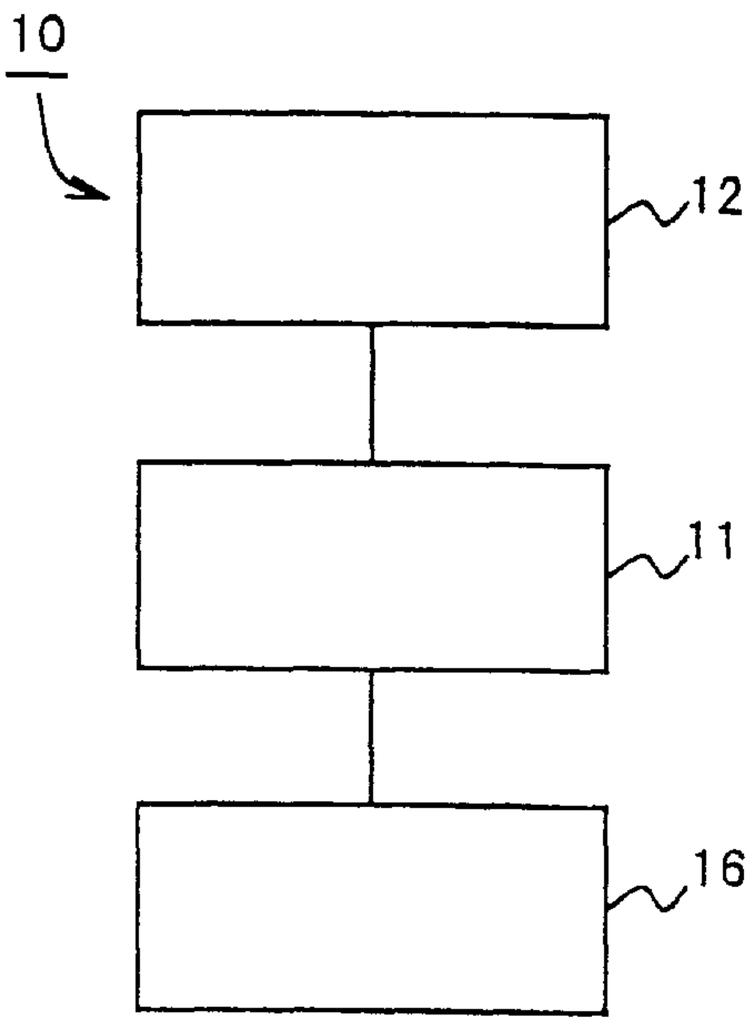
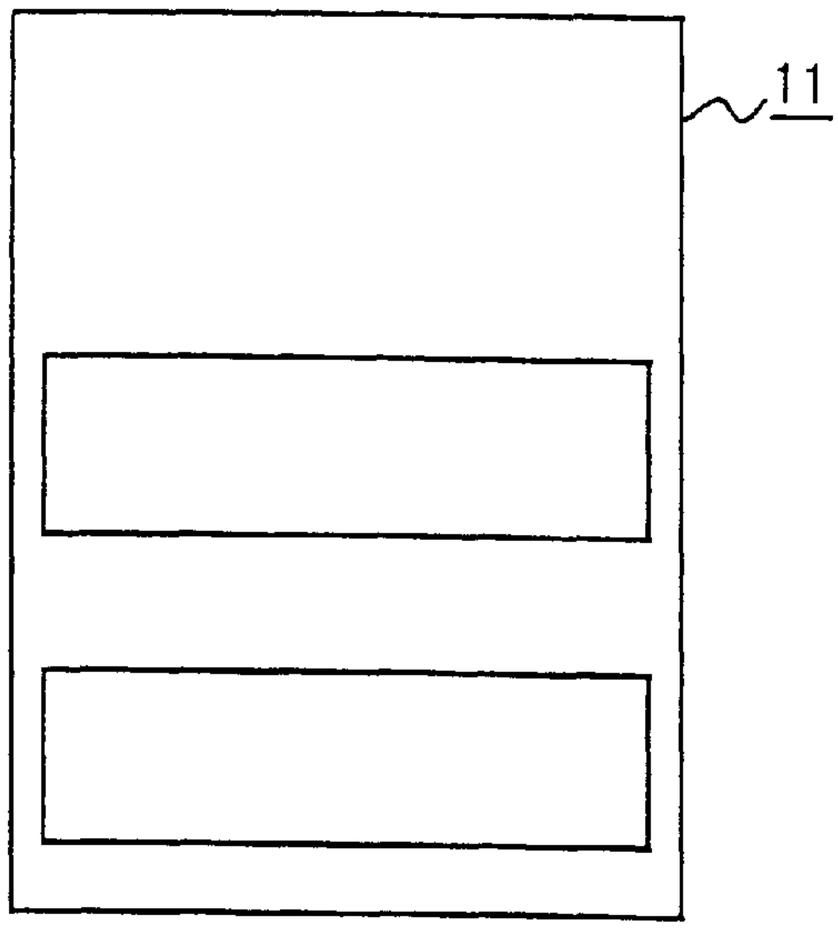


FIG. 46B PRIOR ART



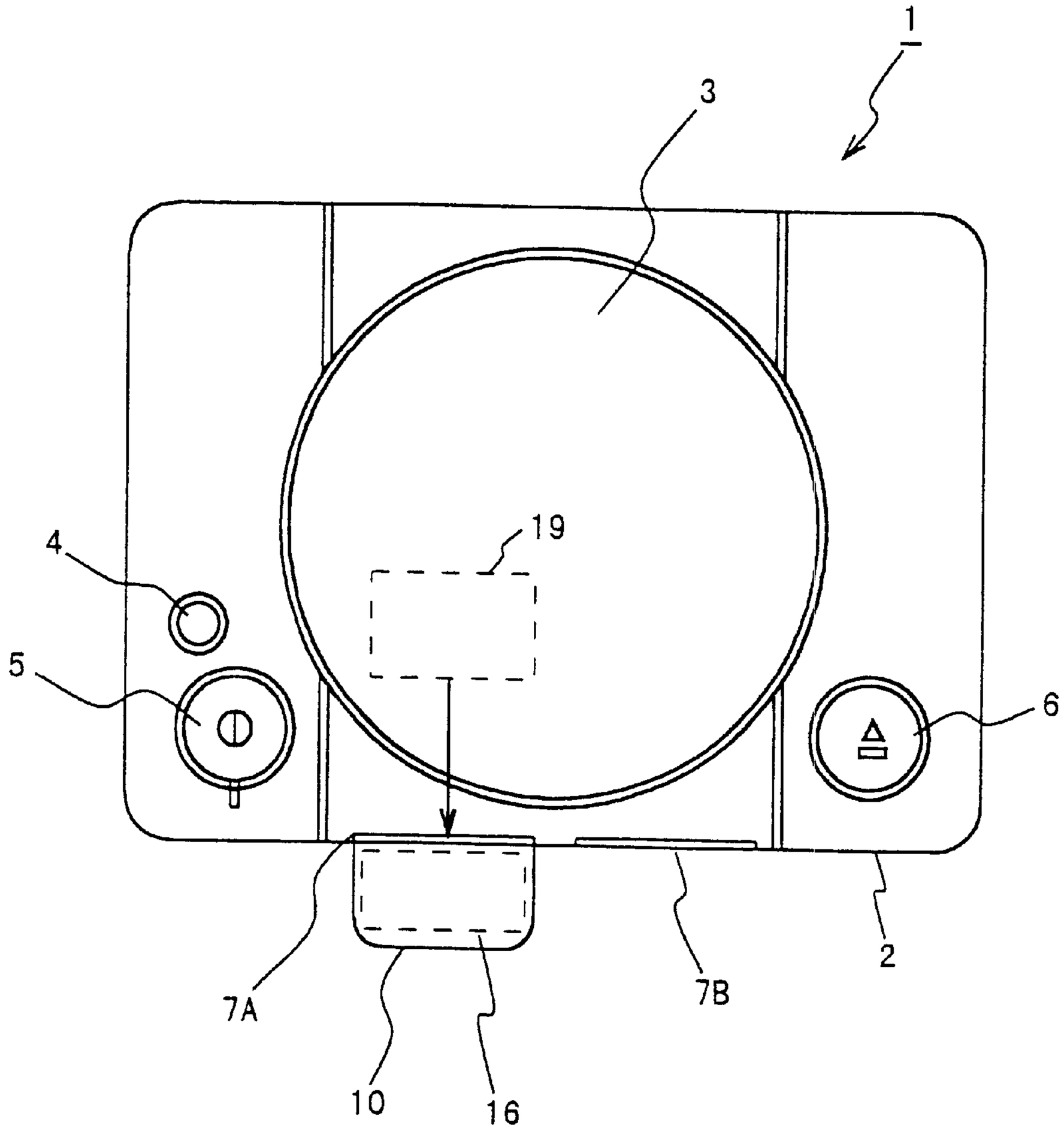


FIG. 47
PRIOR ART

PROTECTIVE CASE FOR PORTABLE ELECTRONIC APPARATUS

TECHNICAL FIELD

This invention relates to a protective case for accommodating a portable electronic device used as a slave or hand-held game machine, etc., of an entertainment system such as a video game station.

BACKGROUND ART

Conventional video game stations include those in which a memory card is capable of being removably inserted. A video game station of this kind is so adapted that data that has been accumulated in the video game station is stored on a memory card in advance and, when necessary, the data can be read out of the memory card and transferred to the video game station.

FIG. **46**A is a block diagram showing the principal components of a memory card capable of being removably inserted into a conventional video game station of this type.

A memory card **10** has control means **11** for controlling the operation of the memory card, a connector **12** for making a connection to a terminal provided in a slot of a video game station, and a non-volatile memory **16** for storing data. The connector **12** and the non-volatile memory **16** are connected to the control means **11**.

The control means **11** is constituted by a microcomputer, by way of example. A flash memory such as an EEPROM, for example, is used as the non-volatile memory **16**.

FIG. **46**B illustrates the items controlled by the control means **11** of the memory card **10**. As illustrated, the memory card **10** has a station connection interface for connection to the console of the video game station, and a memory interface for input and output of data to and from the non-volatile memory.

There is also an arrangement that allows a memory card of the same type to be removably inserted into information equipment other than a video game station.

FIG. **47** is a plan view illustrating an example of the construction of a conventional video game station in which a memory card is capable of being removably inserted.

A conventional video game station **1** has a console **2** accommodated within a substantially quadrangular case, and a centrally provided disk mounting unit **3**. An optical disk serving as a recording medium on which the application program of a video game has been recorded is mounted on the disk mounting unit **3**. The console **2** is provided with a reset switch **4** for resetting the game at will, a power-supply switch **5**, a disk operating switch **6** used when mounting the optical disk on and demounting it from the disk mounting unit **3**, and two slots **7**A and **7**B, by way of example.

The memory card **10** is inserted into at least one of the slots **7**A, **7**B so that data, such as the results of a game that has been run on the video game station **1**, are written to the non-volatile memory **16**.

It is also possible to connect a plurality of controllers (not shown) to the slots **7**A, **7**B, thereby enabling a plurality of users to play competitive games against one each at the same time.

A portable electronic device used as a slave with respect to information equipment such as a video game station has recently been considered. Such a novel portable electronic device is inserted into the slots **7**A, **7**B of the video game station **1** in a manner the same as that of the memory card

10 described above, with the necessary data being downloaded to the device and then used. After the data is downloaded, the device is extracted from the video game station and can be used as a hand-held game machine.

A characteristic of various well-known portable electronic devices, to say nothing of such a novel portable electronic device, is that they are susceptible to moisture and dust because they accommodate electronic circuitry. Accordingly, it is undesirable to carry these portable electronic devices out of doors on rainy or snowy days, to locations where there is the danger of exposure to water, such as the sea, rivers and baths, and to recreation grounds where dust tends to blow about.

However, users desire to carry these devices about even on rainy and snowy days, and there are not a few users who find restrictions on place of use unsatisfactory.

The present invention, which has been devised in view of these circumstances, has as its object to protect a portable electronic device against moisture and dust so that the device can be carried anywhere.

DISCLOSURE OF THE INVENTION

In order to solve the foregoing problem, a protective case according to the present invention has an upper case and a lower case which, by being abutted against each other in order to accommodate a portable electronic device having a manipulator that is operated by being pushed, form a closed space in the interior of which the portable electronic device is capable of being accommodated.

Provided in at least one of the cases is a through-hole at a position opposing the operating element of the portable electronic device accommodated inside the space. The through-hole is closed by a closure member comprising an elastic material and having a push-button that is capable of pushing the operating element of the portable electronic device from the outside. As a result, the operating element of the portable electronic device is capable of being operated externally.

Furthermore, the abutting portion of each case is sealed by a sealing member comprising an elastic material, whereby moisture and dust are positively prevented from penetrating the interior.

By integrally forming the closure member and the sealing member as a continuum, the number of component parts and the number of assembly steps can be reduced and manufacture can be simplified.

In an instance where the accommodated portable electronic device has a display section, it is preferred that an area of the case that opposes the display section of the portable electronic device when the portable electronic device is in the accommodated state be formed in the shape of a concave lens. As a result, it is possible to view the display section of the portable electronic device from the outside in magnified form.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a plan view illustrating the appearance of a video game station according to an embodiment of the present invention;

FIG. **2** is a back view showing the appearance of slots in the video game station;

FIG. **3** is a perspective view showing the appearance of the video game station;

FIG. **4** is a block diagram illustrating schematically the principal components of electrical circuitry constructing the video game station;

FIG. **5** is a plan view illustrating the appearance of a portable electronic device in which a portable electronic device serves as a master according to an embodiment of the present invention;

FIG. **6** is a perspective view showing the appearance of the portable electronic device;

FIG. **7** is a perspective view showing the portable electronic device with a cover member opened;

FIG. **8** is a bottom view showing the appearance of the portable electronic device;

FIG. **9**A is a block diagram showing an example of the arrangement of the principal components of the portable electronic device;

FIG. **9**B is a diagram illustrating items controlled by controlled means shown in FIG. **9**A;

FIG. **10** is a diagram useful in describing a wireless communication function of the portable electronic device;

FIG. **11** is a diagram useful in describing cooperative operation between the portable electronic device and the console of the video game station;

FIG. **12** is a diagram showing the flow of program data downloaded from the video game station to the portable electronic device;

FIG. **13** is a flowchart showing the download procedure;

FIG. **14** is a diagram showing another flow of program data from the video game station to the portable electronic device;

FIG. **15** is a flowchart showing the procedure of the download depicted in FIG. **14**;

FIG. **16**A is a plan view showing the appearance of the portable electronic device;

FIG. **16**B is a front view showing the appearance of the portable electronic device;

FIG. **16**C is a bottom view showing the appearance of the portable electronic device;

FIG. **17** is a right-side view showing the appearance of the portable electronic device;

FIG. **18** is a left-side view showing the appearance of the portable electronic device;

FIG. **19** is a back view showing the appearance of the portable electronic device;

FIG. **20** is a perspective view showing the portable electronic device with the cover member detached;

FIG. **21** is a perspective view showing the process through which the cover member is detached from the portable electronic device;

FIG. **22** is a perspective view showing, in enlarged form, a portion of the portable electronic device that supports the cover member;

FIG. **23** is a perspective view showing, in enlarged form, a support pin of the cover member in the portable electronic device;

FIG. **24** is a sectional view showing, in enlarged form, the support pin of the cover member in the portable electronic device;

FIG. **25** is a sectional view showing, in enlarged form, the state of the support portion in the portable electronic device when the cover member is attached;

FIG. **26** is a sectional view, which follows upon FIG. **25**, showing, in enlarged form, the state of the support portion in the portable electronic device when the cover member is attached;

FIG. **27** is a sectional view, which follows upon FIG. **26**, showing, in enlarged form, the state of the support portion in the portable electronic device when the cover member is attached;

FIG. **28** is a sectional view showing, in enlarged form, the state of the support portion in the portable electronic device when the cover member has been closed;

FIG. **29** is a sectional view showing an operating element provided on the cover member of the portable electronic device;

FIG. **30** is a plan view showing operating elements provided on the cover member of the portable electronic device;

FIG. **31** is a plan view showing another mode of pushers in the portable electronic device;

FIG. **32** is a sectional view showing another mode of pushers in the portable electronic device;

FIG. **33** is a plan view showing the construction of an infrared transceiving portion of the portable electronic device;

FIG. **34** is a sectional view showing the construction of an infrared transmitting portion of the portable electronic device;

FIG. **35** is a sectional view showing the construction of a portion of the portable electronic device that emits visible light for display purposes;

FIG. **36** is a sectional view showing the construction of an infrared receiving portion of the portable electronic device;

FIG. **37** is a back view showing a substrate and a battery insertion portion in the portable electronic device;

FIG. **38** is a back view showing the construction of a battery holder in the portable electronic device;

FIG. **39** is a sectional view showing the construction of a battery holder in the portable electronic device;

FIG. **40** is a perspective view showing another mode of a battery holder in the portable electronic device;

FIG. **41** is a perspective view showing the battery holder of FIG. **40** as seen from a different point of view;

FIG. **42**A is a front view showing a protective case which accommodates the portable electronic device;

FIG. **42**B is a bottom view showing the protective case which accommodates the portable electronic device;

FIG. **43** is a side view the protective case which accommodates the portable electronic device;

FIG. **44**A is a front view showing a portable electronic device that has been accommodated in the protective case;

FIG. **44**B is a bottom view showing a portable electronic device that has been accommodated in the protective case;

FIG. **45** is a side view showing a portable electronic device that has been accommodated in the protective case;

FIGS. **46**A, **46**B are diagrams showing an example of the construction of a conventional memory card; and

FIG. **47** is a diagram showing a conventional video game station that uses a memory card.

BEST MODE FOR CARRYING OUT THE INVENTION

A preferred embodiment according to the present invention will now be described with reference to the drawings.

A portable electronic device accommodated in a protective case embodying the present invention is used as the slave of an entertainment system such as a video game station serving as the master. The portable electronic device can be used as the memory card of the master and can be employed separately as a hand-held game machine as well.

It should be noted that the master is not limited to a video game station and that the portable electronic device serving as the slave need not necessarily have a memory card function.

In the description that follows, the present invention is described in regard to a video game station serving as a master.

FIG. **1** is a plan view showing the appearance of a video game station serving as the master.

The video game station **1** is for reading out a game program that has been recorded on an optical disk or the like and for executing the program in accordance with commands from a user (the player of the game). Executing the game primarily means causing the game to proceed and controlling video and audio that conform to the content of the game.

The video game station **1** has a console **2** accommodated within a substantially quadrangular case, and a centrally provided disk mounting unit **3**. An optical disk serving as a recording medium on which the application program of the video game has been recorded is mounted on the disk mounting unit **3**. The console **2** is provided with reset switch **4** for resetting the game at will, a power-supply switch **5**, a disk operating switch **6** used when mounting the optical disk on and demounting it from the disk mounting unit **3**, and two slots **7**A and **7**B, by way of example.

It should be noted that the recording medium for supplying the application program is not limited to an optical disk. Further, an arrangement may be adopted in which the application program is supplied via a communications line.

Two controllers **20** can be connected to the slots **7**A, **7**B so that two users can play competitive games or the like against each other. The above-mentioned memory card or the portable electronic device embodying the present invention can be inserted into the slots **7**A, **7**B. Though FIG. **1** exemplifies a structure provided with the two slots **7**A, **7**B, the number thereof is not limited to two.

The controller **20** has first and second control portions **21**, **22** as well as a left button **23**L, a right button **23**R, a start button **24** and a select button **25**. The controller further has control portions **31**, **32** capable of analog control, a mode selection switch **33** for selecting the operating mode of the control portions **31**, **32**, and a display portion **34** for displaying the selected operating mode. Provided within the controller **20** is a vibration imparting mechanism, which is not shown.

FIG. **2** shows the appearance of the slots **7**A, **7**B provided in the front side of the console **2** of video game station **1**.

According to this embodiment, the slots **7**A, **7**B have the following components on two levels, one above the other: Specifically, the upper levels of the respective slots are provided with memory card insertion portions **8**A, **8**B for inserting the above-mentioned memory card **10** or a portable electronic device **100**, described later, and the lower levels of the respective slots are provided with controller connecting portions jacks) **9**A, **9**B for connecting a connection terminal (connector) **26** of the controller **20**.

Structurally, the insertion hole (slot) of each of the memory card insertion portions **8**A, **8**B is formed to have a transversely elongated rectangular shape, and the corners at both ends on the lower side thereof are made rounder than the corners at both ends on the upper side so that a memory card cannot be inserted in the wrong direction. Shutters for protecting the connection terminals provided within the memory card insertion portions **8**A, **8**B are reclosably provided in the openings to the memory card insertion portions.

Structurally, the controller connecting portions **9**A, **9**B, on the other hand, each have an insertion hole of a transversely elongated rectangular shape, and the corners at both ends on the lower side thereof are made rounder than the corners at both ends on the upper side, whereby the connection terminal **26** of the controller **20** cannot be connected in the wrong direction. Furthermore, the insertion hole of each of the controller connecting portions **9**A, **9**B is provided with a shape different from that of the insertion holes of the memory card insertion portions **8**A so that a memory card or the like will not be inserted by mistake.

FIG. **3** is a diagram showing a state in which the portable electronic device **100** (described later) according to this embodiment has been inserted into the memory card insertion portion **8**A of slot **7**A formed in the front side of the video game station **1**.

FIG. **4** is a block diagram showing schematically the principal components of the electrical circuitry constructing the above-described video game station **1** serving as a master.

The video game station **1** has a control system **50** comprising a central processing unit (CPU) **51** and its peripherals; a graphics system **60** comprising a graphic processing unit (GPU) **62**, etc., for drawing graphics in a frame buffer **63**; a sound system **70** comprising a sound processing unit (SPU), etc., for generating music and sound effects, etc.; an optical-disk controller **80** for controlling an optical disk on which an application program has been recorded; a communications controller **90** for controlling input and output of data to and from the memory card **10** or portable electronic device **100**, described later; and a bus denoted BUS to which each of the foregoing components is connected.

The control system **50** among these components has the CPU **51**, a peripherals controller **52** for performing control such as interrupt control and control of direct memory access (DMA) transfer, a main memory **53** comprising a random-access memory (RAM); and a read-only memory (ROM) **54**.

The main memory **53** mentioned here refers to a memory in which programs can be executed. A program such as a so-called operating system for controlling the main memory **53**, graphics system **60** and sound system **70**, etc., has been stored in the read-only memory **54**.

The CPU **51**, which performs overall control of the video game station **1** by executing the operating system that has been stored in the ROM **54**, is constituted by a 32-bit RISC-CPU, by way of example.

When power is introduced to the video game station **1** constructed as set forth above, the CPU **51** included in the control system **50** runs the operating system stored in the ROM **54** to thereby control the graphics system **60** and sound system **70**, etc.

Further, when the operating system is run, the CPU **51** initializes the video game station **1** and then controls the optical-disk controller **80** to execute an application program such as a game that has been recorded on an optical disk. On the basis of the program, the CPU **51** controls the graphics system **60** and sound system **70**, etc., in conformity with user commands entered from the controller **20**, thereby controlling the display of images and the generation of sound effects and music.

The graphics system **60** has a geometry transfer engine (GTE) **61** for executing coordinate transformation and the like, the GPU **62** for drawing graphics in accordance with a draw command from the CPU **51**, a frame buffer **63** for storing an image drawn by the GPU **62**, and an image decoder **64** for decoding image data that has been compressed and encoded by an orthogonal transformation such as a discrete cosine transformation.

The GTE **61**, which has a parallel operation mechanism for executing a plurality of arithmetic operations in parallel, is capable of executing a coordinate transformation, light-source calculation and matrix or vector operation, etc., at high speed in response to an operation request from the CPU **51**.

By way of example, in a calculation where one polygon of a triangular shape is rendered (subjected to flat shading) in the same color, the GTE **61** is capable of calculating the coordinates of a maximum of 1,500,000 polygons in one second. As a result, the video game station **1** is capable of reducing the load upon the CPU **51** and of calculating coordinates at high speed.

The GPU **62** draws polygons and the like in the frame buffer **63** in accordance with a draw command from the CPU **51**. The GPU **62** has the ability to draw a maximum of 360,000 polygons in one second.

The frame buffer **63**, which comprises a dual-port RAM, is capable of performing simultaneously the transfer of draw data from the GPU **62** or main memory and read-out for displaying what has been drawn The frame buffer **63**, which has a capacity of 1 MB, is treated as a 16-bit matrix composed of 1024 pixels in the horizontal direction and 512 pixels in the vertical direction.

Further, the frame buffer **63** is provided with a CLUT area and a texture area in addition to a display area from which data is output as video. A color look-up table (CLUT) to which reference is had when the GPU **62** draws polygons or the like is stored in the CLUT area. Texture inserted into (mapped to) polygons drawn by the GPU **62** is stored in the texture area. The CLUT area and texture area change dynamically in accordance with a change, etc., in the display area.

Besides performing the flat shading mentioned above, the GPU **62** is capable of executing Gouraud shading, which decides the color in a polygon by interpolation from the colors at the apices of the polygon, and texture mapping, in which texture that has been stored in the texture area is mapped to polygons. In a case where Gouraud shading or texture mapping is carried out, the GTU **61** is capable of calculating the coordinates of a maximum of 500,000 polygons in one second.

Under control of the CPU **51**, the image decoder **64** decodes image data representing still or moving images stored in the main memory **53**, and stores the decoded data in the main memory **53**. The image data thus reproduced is stored in the frame buffer **63** via the GPU **62**, whereby the image data is capable of being used as the background of the image drawn by the GPU **62**.

The sound system **70** has an SPU **71** for generating music and sound effects based upon a command from the CPU **51**, a sound buffer **72** in which data such as waveform data is recorded, and a speaker **73** for outputting music and sound effects, etc., generated by the SPU **71**.

The SPU **71** has an ADPCM decoding function for reproducing audio data obtained by adaptive differential PCM (ADPCM) using 16-bit audio data as a 4-bit differential signal, a reproducing function for generating sound effects and the like by reproducing waveform data that has been stored in the sound buffer **72**, and a modulating function for modulating and reproducing the waveform data that has been recorded in the sound buffer **72**.

Provision of these functions enables the sound system **70** to generate music and sound effects, based upon the waveform data recorded in the sound buffer **72**, in response to a command from the CPU **51**, thus making it possible for the sound system to be used as a so-called sampling sound source.

The optical-disk controller **80** has an optical disk device **81** for reproducing programs, data and the like that have been recorded on an optical disk, a decoder **82** for decoding programs, data and the like that have been recorded following assignment of, e.g., error correction codes (ECC) thereto, and a buffer **83** in which data from the optical disk device **81** is stored temporarily, thereby speeding up the read-out of data from the optical disk. A subordinate CPU **84** is connected to the decoder **82**.

In addition to ADPCM data, so-called PCM data, which is the result of subjecting an audio signal to an analog-to-digital conversion, is an example of audio data recorded on the optical disk and read out by the optical disk device **81**.

As for ADPCM data, audio data that has been recorded using four bits to express, e.g., a 16-bit digital data differential is decoded by the decoder **82**, after which the decoded data is supplied to the SPU **71**. Here the data is subjected to processing such as a digital/analog conversion and then is output to the speaker **73**.

As for PCM data, audio data that has been recorded as, e.g., 16-bit digital data is decoded by the decoder **82** and is then output to the speaker **73**.

The communications controller **90** has a communications control circuit **91** for controlling communication with the CPU **51** via the bus denoted BUS. The controller connecting portions **9**A, **9**B and memory card insertion portions **8**A, **8**B are each connected to the communications control circuit **91**.

The controller **20** is connected to the controller connecting portions **9**A, **9**B and is provided with, say, 16 operating keys so that the user may enter operating information. In accordance with a command from the communications control circuit **91**, the controller **20** transmits the states of these operating keys to the communications control circuit **91** at a cycle of 60 times per second by synchronous communication. The communications control circuit **91** transmits the sent states of the operating keys to the CPU **51**. As a result, the operating information from the user is input to the CPU **51** which, on the basis of the game program, etc., currently being run, executes processing that is in accordance with the user operating information.

It is required that a large quantity of data be transferred at high speed when program read-out, image display and drawing of graphics, etc., are executed by cooperation among the main memory **53**, GPU **62**, image decoder **64** and decoder **82**. Accordingly, the video game station **1** is so adapted that a direct transfer of data (so-called DMA transfer) can be carried out among the main memory **53**, GPU **62**, image decoder **64** and decoder **82** by control from the peripherals controller **52** without the intervention of the CPU **51**. As a result, the load on the CPU **51** that accompanies data transfer can be alleviated and high-speed data transfer becomes possible.

When it is necessary to store setup data and the like relating to a game currently being run, the CPU **51** transmits the data that is to be stored to the communications control circuit **91**. Upon receiving the data sent from the CPU **51**, the communications control circuit **91** writes the data to the memory card **10** or portable electronic device **100** that has been inserted into the slot of memory card insertion portion **8**A or **8**B. It should be noted that the communications control circuit **91** has a built-in protection circuit to prevent electrical destruction.

The memory card **10** and portable electronic device **100**, which are separate from the bus denoted BUS, can be inserted and extracted in a state in which the game station console is being supplied with power. In situations where the

storage capacity of the memory card **10** or portable electronic device **100** is no longer adequate, therefore, a new memory card **10** or portable electronic device **100** can be substituted for the old without cutting off power to the console **2**. This makes it possible for game data requiring power back-up to be written to the newly inserted memory card **10** or portable electronic device **100** without being lost.

A parallel I/O interface (PIO) **96** and a serial I/O interface (SIO) **97** are interfaces for connecting the memory card **10** and portable electronic device **100** to the video game station **1**.

The portable electronic device embodying the present invention will be described next.

The portable electronic device **100** used as the slave of the video game station **1** (the master), described above, will be discussed.

The portable electronic device **100** serving as the slave is inserted into either of the memory card insertion portions **8**A, **8**B provided in the slots **7**A, **7**B, respectively, of the video game station **1** (master). Portable electronic devices can be used also as unique memory cards corresponding to a plurality of connected controllers **20**. For example, in an instance where two users (game players) play the game, the two portable electronic devices **100** function so that the game results of the individual users can be recorded on the respective ones of the portable electronic devices.

The connector of the memory card **10** or portable electronic device **100** is so adapted that the conductor of the connection terminal for the power supply or for ground is formed to be longer than the other terminals in such a manner that the power-supply terminal or ground terminal will form an electrical connection first when the memory card **10** or portable electronic device **100** is inserted into the memory card insertion portions **8**A, **8**B. This is to ensure the safety and stability of electrical operation. An arrangement may be adopted in which the connection conductors of the memory card insertion portions **8**A, **8**B provided in the video game station **1** are formed to be longer, or in which both of the conductors are formed to be longer.

Further, the connector portions are formed to have left/right asymmetry in order to prevent the memory card **10** and portable electronic device **100** from being inserted in the wrong attitude.

FIGS. **5** to **8** illustrate the appearance of the portable electronic device **100**, in which FIG. **5** is a plan view of the portable electronic device **100**, FIG. **6** a perspective view in which a cover member **110** for protecting the connector portion is shown in the closed state, FIG. **7** a perspective view showing the cover member **110** in the open state, and FIG. **8** a bottom view of a housing **101** in a state in which the cover member **110** has been detached.

As shown in FIGS. **5** to **7**, the portable electronic device **100** has a housing **101** serving as a casing. The housing **101** is provided with an operating section **120** having one or a plurality of operating elements **121**, **122** for entering events and making various selections, a display section **130** comprising a liquid crystal display device (LCD), and a window **140** for performing wireless communication, as by infrared, by wireless communications means, described later.

The housing **101** comprises an upper shell **101***a* and a lower shell **101***b* and houses a substrate **151** mounting memory devices and the like (see FIG. **8**). The housing **101** is capable of being inserted into the slots **7**A, **7**B in the console of the video game station **1**, as will be described later. The base end of the housing **101** has a side face provided with a connector portion **150** having a rectangular-shaped opening.

The window **140** is provided in the generally semi-circular distal end of the housing **101**. The display section **130** is provided on the top side of the housing **101** in an area (an area in the vicinity of the window **140**) that occupies approximately half of the top surface on the distal-end side. The operating section **120** is provided on the top side of the housing **101** in an area (an area in the vicinity of the connector portion **150**) that occupies approximately half of the top surface on the base-end side.

The operating section **120** has a substantially quadrangular shape and is constituted by a cover member **110**, which is pivotally supported on the housing **101** and has one or plurality of operating elements **121**, **122**, and switch pushers **102**, **103** provided at a position opened and closed by the cover member **110** on housing **101** (see FIG. **7**).

The operating elements **121**, **122** are disposed passing through the cover member **110** from its upper to its lower side. The operating elements **121**, **122** are supported on the cover member **110** in such fashion as to be movable in a direction in which they recede from the top side of the cover member **110**.

By pushing the switch pushers **102**, **103** from above, push switches such as diaphragm switches disposed on the substrate **151** in the housing **101** are pushed.

The switch pushers **102**, **103** are provided at positions that oppose the operating elements **121**, **122** when the cover member **110** is closed. More specifically, when the operating elements **121**, **122** are pushed from above with the cover member **110** in the closed state, the pushing forces are transmitted to the corresponding push switches in the housing **101** via the opposing switch pushers **102**, **103**, whereby the push switches are actuated.

It should be noted that a flexible protective sheet may be affixed on the switch pushers **102**, **103**. By affixing the protective sheet, the pressuring elements of the switch pushers **102**, **103** can be pushed directly by one's finger from above the protective sheet without the intermediary of the operating elements **121**, **122**. In addition, dust can be prevented from penetrating the interior of the housing **101** from the switch pushers **102**, **103**.

As shown in FIG. **8**, power and signal terminals **152** disposed on the substrate **151** are provided inside the connector portion **150** in an exposed condition. The shape, dimensions, etc. of the connector portion **150** have specifications common with those of the ordinary memory card **10** used with the video game station **1**.

FIG. **9**A is a block diagram showing an example of the arrangement of the principal components of the portable electronic device.

In a manner similar to the ordinary memory card **10** described above, the portable electronic device **100** has control means **41** for controlling its operation, a connector **42** for effecting a connection to a slot of information equipment or the like, and a non-volatile memory **46** serving as a device for storing data.

The control means **41**, which is constituted by, say, a microcomputer, has an internally provided program memory **41***a*. A semiconductor memory device such as a flash memory in which the state of recorded data remains intact even when power is cut off is used as the non-volatile memory **46**. It should be noted that because the portable electronic device **100** according to the present invention is configured to be equipped with a battery **49**, as will be described later, a static random-access memory (SRAM) capable of high-speed input/output of data can be used as the non-volatile memory **46**.

In addition to the components mentioned above, the portable electronic device **100** has operation (event) input means **43** such as an operating button for operating a stored program, display means **44** such as a liquid crystal display device (LCD) serving as display means for displaying various information in conformity with the above-mentioned program, wireless communications means **48** for sending data to and receiving data from another memory card or the like by infrared radiation, and a battery **49** for powering each of the foregoing components.

The portable electronic device **100** internally accommodates a miniature battery **49** as power supply means. This means that the portable electronic device is capable of operating independently even if it has been pulled out of the slots **7**A, **7**B of the video game station **1** constituting the master. A rechargeable secondary cell may be used as the battery **49**.

It is so arranged that the portable electronic device **100** serving as the slave is supplied with power from the video game station **1** serving as the master when the portable electronic device **100** has been inserted into either of the slots **7**A, **7**B of the video game station **1**. That is, a power-supply terminal **50** is connected to the connection terminal of the battery **49** via a diode **51** for preventing reverse current. When the portable electronic device is inserted into the slot of the master, such as the video game station **1**, the power-supply terminal **50** becomes connected to the power-supply terminal on the master side so that power is supplied from the master to the slave. Furthermore, in a case where a secondary cell is being used, charging of the secondary cell takes place at the same time.

The portable electronic device **100** further includes a clock **45** and a speaker **47**, which serves as sound generating means for generating sound in conformity with the program. It should be noted that the above-mentioned components are all connected to the control means **41** and operate in accordance with control exercised by the control means **41**.

FIG. **9**B illustrates the items controlled by the control means **41**. Though the only interfaces with which the ordinary memory card **10** is equipped are the interface for the connection to the console of the information equipment and the memory interface for input/output of data with respect to memory, as mentioned earlier, the portable electronic device **100** according to this embodiment has, in addition to these interfaces, a display interface, an operation-input interface, an audio interface, a wireless communications interface, a clock interface and a program-download interface.

Thus, the interfaces (drivers) for managing the functions added by the present embodiment are provided in the portable electronic device **100** independently of the console (master) connection interface and independently of non-volatile memory management, which are the conventional functions possessed by the memory card **10**. For this reason compatibility with the conventional functions can be maintained.

Further, since the portable electronic device **100** has the input means **43**, such as a button switch, for operating an executed program, and the display means **44** comprising the liquid crystal display device (LCD) or the like, the portable electronic device is capable of being used as a hand-held game machine.

Moreover, since the portable electronic device **100** possesses a function for storing programs and data, which are downloaded from the console of the video game station **1**, in the program memory **41***a* in control means **41**, application programs can be run on the portable electronic device **100**. The stored application programs and various types of driver software can be altered with facility.

The portable electronic device **100** according to this embodiment can be controlled independently of the video game station **1**, as described above. On the side of the portable electronic device **100**, therefore, data based upon an application program that has been stored in the program memory **41***a* serving as the program storage means can be created independently of the application software on the side of the video game station **1**. By exchanging this data with the video game station **1**, the portable electronic device **100** constituting the slave and the video game station **1** constituting the master are capable of cooperative (linked) operation.

Furthermore, the fact that the portable electronic device **100** is equipped with the clock **45** makes it possible for time data to be shared with the video game station **1**. In other words, not only is mutual time data made to coincide but both the video game station and the portable electronic device also share data that is for controlling, in real time, the progress of games that are run on them independently.

A specific example of the cooperative operation (linking) between the video game station **1** and portable electronic device **100** will be described later.

FIG. **10** illustrates schematically the manner in which wireless communication is performed between a plurality of the portable electronic devices **100** according to the present invention.

By thus utilizing the wireless communications means **48**, the portable electronic device **100** can exchange internal data with a plurality of portable electronic devices **100** by sending and receiving data via the window **140**. The internal data includes also data that has been transferred from the side of information equipment, such as the video game station, and stored in storage means within the portable electronic device **100**.

In the embodiment set forth above, the portable electronic device **100** is described as being used as the slave of a video game station. However, this does not impose a limitation upon the present invention because the device can be applied also to, e.g., the retrieval of various information.

The invention will now be described in regard to cooperative operation (linking) between the portable electronic device **100** and the video game station **1** serving as the master.

As mentioned above, the portable electronic device **100** (slave) and the video game station **1** (master) can share game data generated by the control means **41**, time data obtained by the clock **45**, and data generated by another portable electronic device **100** and obtained via the wireless communications means **48**, etc.

FIG. **11** illustrates schematically the manner in which the video game station **1** serving as the master and the portable electronic device **100** serving as the slave perform a cooperative (linked) operation.

Described below as an example of such cooperative operation is a case where an optical disk (CD-ROM), which is a recording medium on which an application software program has been recorded, has been loaded in the video game station **1** serving as the master, and the program read out of the disk is downloaded to the portable electronic device **100** serving as the slave inserted into either of the slots **7**A, **7**B of the video game station **1**.

Downloading of a program on the assumption that it is for performing a cooperative operation will be discussed before giving a specific description regarding the cooperative operation.

FIG. **12** illustrates the flow of data in an instance where the application program of a video game supplied from an optical disk (CD-ROM), etc., mounted on the disk mounting unit **3** of the master video game station **1** is transferred directly (downloaded) to the program memory **41***a* in the control means (microcomputer) **41** of portable electronic device **100** via the control means (CPU) **51** of video game station **1**.

FIG. **13** is a flowchart illustrating the download procedure.

At step ST**1**, the application program of a video game that runs on the control means **41** in the slave portable electronic device **100** (referred to simply as the "slave" hereafter) is read as data out of the CD-ROM that has been mounted on the disk mounting unit **3** of the master video game station **1** (referred to simply as the "master" hereafter). As mentioned earlier, this application program generally is different from that which runs on the master video game station **1**.

Next, at step ST**2**, the control means (CPU) **51** of the master issues a "program download request command" to the control means (microcomputer) **41** of the slave portable electronic device **100**. The control means (CPU) **51** of the master performs polling in order to accept "program download permission status" from the control means (microcomputer) **41** of the slave. The polling mentioned here refers to a method of performing a service upon inquiring as to whether the service has been requested or not.

The control means (microcomputer) **41** on the slave side accepts the "program download request command" from the control means (CPU) **51** of the master at step ST**3**.

When the control means (microcomputer) **41** on the slave side ends the routine currently being processed and a state in which program download can be executed is attained, the control means sends "program download permission status" back to the control means (CPU) **51** of the master at step ST**4**.

Next, upon accepting "program download permission status" from the control means (microcomputer) **41** on the slave side at step ST**5**, the control means (CPU) **51** of the master transfers (downloads) and writes the program, which was read out of the CD-ROM at step ST**1**, to the program memory **41***a* of portable electronic device **100**. The control means (CPU) **51** of the master performs polling in order to accept "program-start permission status" from the control means (microcomputer) **41** of the slave.

The address of the program memory **41***a* to which the downloaded data is written is managed by the control means (microcomputer) **41** of the slave at this time. In the description rendered above, it was assumed that the program downloaded from the master will be stored in the program memory **41***a* within the control means (microcomputer) **41** of the slave. However, this does not impose a limitation, for an arrangement may be adopted in which the program is stored in a storage device such as an SRAM that is capable of inputting and outputting data at high speed.

The control means (microcomputer) **41** of the slave accepts as data the program that has been transferred from the master and writes this data to the program memory **41***a* at step ST**6**. From the point of view of the control means (CPU) **51** of the master, it appears that the program data is being written directly to the program memory **41***a* of the slave. In addition, the address of the program memory **41***a* is managed by the control means (microcomputer) **41** of the slave, as set forth above.

Upon accepting the final program data from the master and then establishing an environment in which the program can be executed, the control means (microcomputer) **41** of the slave portable electronic device **100** sends "program-start permission status" back to the control means (CPU) **51** of the master at step ST**7**.

The control means (CPU) **51** of the master accepts "program-start permission status" from the control means (microcomputer) **41** of the slave and issues a "program-start command" at step ST**8**.

Upon receiving the "program-start command" from the control means (CPU) **51** of the master, the control means (microcomputer) **41** of the slave starts running the program from a predetermined starting address.

By way of the foregoing procedure, the application program is transferred directly (downloaded) from the master video game station **1** to the program memory **41***a* in the control means (microcomputer) **41** of the slave (portable electronic device **100**) that has been inserted.

As mentioned above, the means which supplies the application program is not limited to a storage medium such as the optical disk, and an arrangement in which it is supplied via a communication line may be adopted. Only step ST**1** would differ in the above-described procedure in such case.

It should be noted that the foregoing download procedure is for a case where the application program is downloaded directly from the master (video game station **1**) to the program memory **41***a* in the control means (microcomputer) **41** of the slave (portable electronic device **100**) that has been inserted.

By contrast, there is also a case where the control means (CPU) **51** of the master downloads the data of an application program to the non-volatile memory **46** in the slave (portable electronic device **100**), after which this data is copied to the program memory **41***a* in the control means (microcomputer) **41**, where the program is then executed.

FIG. **14** illustrates the flow of data in such case. Specifically, the application program of a video game supplied from an optical disk or the like mounted on the disk mounting unit **3** of the master (video game station **1**) is transferred (downloaded) to the non-volatile memory **46** in the slave (portable electronic device **100**) via the control means (CPU) **51** of the master, after which the program is copied to the program memory **41***a* in the control means (microcomputer) **41** and executed.

FIG. **15** is a flowchart illustrating the download procedure.

At step ST**11**, the application program of a video game that runs on the control means (microcomputer) **41** in the slave (portable electronic device **100**) is read as data out of the CD-ROM that has been mounted on the disk mounting unit **3** of the master (video game station **1**).

Next, at step ST**12**, the control means (CPU) **51** of the master transfers (downloads) the program data read out of the CD-ROM to the non-volatile memory **46** of the slave. This procedure is similar to that of the case where data is backed up in the conventional video game station.

Next, at step ST**13**, through a procedure similar to that of the conventional data backup, the control means (microcomputer) **41** of the slave accepts as data the application program that has been transferred from the control means (CPU) **51** of the master and writes this data to the non-volatile memory **46**.

This is followed by step ST**14** where, upon receiving a "program-start request command" from the control means (CPU) **51** of the master, the control means (microcomputer) **41** of the slave copies data of a designated size from an

address of the non-volatile memory **46** designated by the above-mentioned command to the program memory **41***a* in the control means (microcomputer) **41** of the slave.

The control means (microcomputer) **41** of the slave executes the program, which was copied to the program memory **41***a,* from the starting address of this memory.

By way of the foregoing procedure, the program of the application software is transferred (downloaded) as data, via the non-volatile memory **46**, from the master video game station **1** to the program memory **41***a* in the control means (microcomputer) **41** of the slave (portable electronic device **100**) that has been inserted.

It should be noted that the application program downloaded from the video game station **1** to the portable electronic device **100** generally is different from that which runs on the master video game station **1**. Of course, the above-mentioned downloaded application program may be one that runs on both the video game station **1** and the portable electronic device **100**. In such case, however, a constraint imposed is that the control means (CPU) **51** on the side of the video game station **1** and the control means (microcomputer) **41** on the side of the portable electronic device **100** be identical processors.

Described next will be cooperative operation (linkage) performed while the application software that has been downloaded from the master video game station **1** through the foregoing procedure is executed in the slave portable electronic device **100** independently and the result of execution is again exchanged with the video game station **1**.

Here attribute data of personages or characters that appear in a so-called role-playing game that runs on the video game station **1** of the master is downloaded to the portable electronic device **100** of the slave. The attribute data is data that represents extent of growth, personality, etc.

By nurturing the appearing personages or characters in the program executed by the control means (microcomputer) **41** within the slave portable electronic device **100**, the attributes thereof are caused to change independently of the program executed by the video game station **1**.

The portable electronic device **100** embodying the present invention is configured so as to operate independently and, moreover, is small in size and convenient to carry about. As a result, the personages and characters that make an appearance owing to the program run on the portable electronic device **100** can be carried about and nurtured by the user (the player of the game) at any time. The attributes of the appearing personages and characters nurtured under the care of the user can also be transferred (uploaded) from the portable electronic device **100** to the video game station **1** by the user. In this case the appearing personages and characters whose attributes have been changed can be incorporated in the program being run on the master video game station **1** and made to act in the program.

Thus, as described above, it is possible to implement a video game in which cooperative operation can be carried out by sharing the attribute data of personages and the like with both the video game station **1** constituting the master and portable electronic device **100** constituting the slave and by causing the attribute to change in each of these devices

The structure of the components making up the above-described portable electronic device **100** will now be described in greater detail.

The portable electronic device **100** is accommodated in the housing **101** and has the terminals **152** for connection to external equipment (see FIG. **8**), as mentioned above. The terminals **152** are exposed within the connector portion **150** provided in the housing **101**. The connector portion **150** is protected by being covered by the cover member **110**, as shown in FIGS. **16**A to **18**.

The cover member **110** is pivotally supported by the housing **101** between a closed state, in which it covers the terminals **152**, and an open state, in which it exposes the terminals **152** to the outside.

More specifically, as shown in FIG. **20**, the cover member **110** has two arms **113**, **113**, the two arms **113**, **113** have opposing support pins **111**, **112**, and the support pins **111**, **112** are fitted (see FIG. **21**) into two support holes **107**, **107** provided in the top of the housing **101** on both sides thereof substantially at its central portion, whereby the cover member **110** is pivotally supported.

The housing **101** is provided with the pushers **102**, **103** which, by being pushed, push the push switches **157** disposed on the substrate **151** and connected to electronic circuitry, as described earlier.

As shown in FIG. **29**, the cover member **110** is provided with the operating elements **121**, **122** movably supported by the cover member **110** in a state in which the operating elements penetrate the cover member **110**. As shown in FIG. **30**, the operating elements **121**, **122**, which are molded as an integral part of runners **123** formed of a flexible material such as a synthetic resin, are capable of moving elastically using the resiliency of the runners **123**.

The pushers **102**, **103** may be formed separate from the housing **101** or, as shown in FIGS. **31** and **32**, they may be constructed from part of the shell of housing **101**. In the latter case, the portions defined by cuts **102***a,* **103***a* provided in the shell of the housing **101** would constitute the switch pushers **102**, **103**. Slits **102***b,* **103***b* are provided on the base-end sides of the switch pushers **102**, **103** so that the switch pushers **102**, **103** are capable of resilient displacement relative to the housing **101**. A flexible protective sheet **101***c* is affixed to the top side of the portion where the switch pushers **102**, **103** are constructed. By affixing the protective sheet, the switch pushers **102**, **103** can be pushed directly by one's finger from above the protective sheet without the intermediary of the operating elements **121**, **122**, and dust is prevented from penetrating the interior of the housing **101** from the switch pushers **102**, **103**. The housing **101** is so adapted that when the cover member **110** has been opened, the portion that includes the connector **150** is fitted into either of the slots **7**A, **7**B, which are recessed holding portions of the external equipment, so that the terminals **152** are made to connect with the external equipment as shown in FIG. **3**.

The cover member **110** is removably attached to the housing **101**, as illustrated in FIGS. **20** and **21**. Specifically, as shown in FIGS. **23** and **24**, at least one support pin **111** of the support pins **111**, **112** of cover member **110** has a hollow portion that is open to the distal end and circumferential surface portion of the pin, as a result of which the pin is capable of being diametrically constricted resiliently in one direction. As shown in FIG. **22**, the housing **101** is formed to have a groove **108** extending from the support hole **107**, into which the diametrically constrictable support pin **111** is fitted, to the side of the housing **101**. As shown in FIGS. **25** to **27**, the cover member **110** is capable of being removably attached to the housing **101** by passing the diametrically constrictable support pin **111** through the interior of the groove **108** in the diametrically constricted state.

The support pin **111** can be passed through the interior of the groove **108** in this manner when the cover member **110**

is open. When the cover member **110** has been closed, the direction in which the support pin **111** is capable of diametrically constricted assumes a direction orthogonal to the width direction of the groove **108**, as shown in FIG. **28**. As a result, the support pin **111** can not be passed through the groove **108**.

As shown in FIG. **33**, the portable electronic device **100** has an optical system for guiding, in two directions, light from a display light source (LED) **145**, which emits visible light for display purposes, and for making it possible for a light-receiving element **144**, which receives infrared light for infrared communications with the external equipment, to receive infrared light from two directions.

"The two directions in which light from the display light source **145** is guided" and "the two directions in which the light-receiving element **144** receives infrared light" that are mentioned here refer to the side of the window **140** and the side of the display section **130**. The window **140**, which is provided on the upper end of the housing **101**, is for allowing the infrared light to be projected outwardly from the housing **101**. The infrared light is emitted by an infrared light source (LED) **146** and is for performing infrared communications with the external equipment.

The optical system includes a transparent protecting plate **131** for protecting the display section **130**, and a prism **141** serving as an optical device provided in the window **140**. As mentioned above, the display section **130** is disposed in the housing **101**, constitutes display means facing toward the outside of the housing **101** via a through-hole provided in the front side of the housing **101**, and comprises a liquid crystal display device (LCD).

The transparent protecting sheet **131** comprises a transparent material, such as an acrylic material, and is disposed so as to close the through-hole portion. The prism **141** also comprises a transparent material, such as an acrylic material, and is disposed so as to close the window **140**.

The display section **130** is directed toward the front side of the housing **101** and is disposed to point in a direction different from that of the window **140** provided on the upper end of the housing **101**. The infrared light source **146** is situated above the display section **130** and is disposed on the substrate **151** inside the housing **101**. The display light source (LED) **145** that emits the visible light for display is situated above the display section **130** and is disposed on the substrate **151** inside the housing **101**.

The light-receiving element **144**, which receives the infrared light for performing infrared communications with the external equipment, is situated above the display section **130** and is disposed on the substrate **151** inside the housing **101**. The infrared light source **146**, display light source **145** and light-receiving element **144** are arrayed substantially in a single row.

As shown in FIG. **34**, the prism **141** transmits the infrared light, which is emitted toward the window **140** by the infrared light source **146**, through the window **140** so that the light is caused to exit from the housing **101**. As shown in FIG. **35**, the prism **141** has a projection **142** upon which the visible light emitted toward the display section **130** by the display light source **145** impinges. The visible light is reflected at the interface and is guided toward the side of the window **140**, whence it is allowed to exit to the outside. Visible light that has passed through the projection **142** impinges upon the transparent protecting plate **131** from a projection **132** possessed by the transparent protecting plate **131**, passes through the transparent protecting plate **131** and exits to the outside from the side of display section **130**. Thus, the window **140** allows not only the infrared light emitted by the infrared light source **146** to exit to the outside of the housing **101** but also the visible light emitted by the display light source **145**.

As shown in FIG. **36**, the prism **141** has a projection **143** at the interface of which the infrared light that has entered from the window **140** is reflected so as to be guided toward the light-receiving element **144**, where the infrared light is received. The infrared light incident upon the transparent protecting plate **131** from the side of the display section **130** enters the interior of the projection **143** of prism **141** from the projection **133** of the transparent protecting plate **131**, passes through this projection and is received by the light-receiving element **144**. Thus, the light-receiving element **144** receives infrared light from two directions, namely from the side of display section **130** and from the side of window **140**.

A battery inserting structure formed on the back side of the housing **101** will be described with reference to FIG. **19** and FIGS. **37** to **41**.

As mentioned above, the portable electronic device **100** is constructed to receive a battery **155** for supplying power. Specifically, a recessed battery insertion portion **200** is formed in the back side of the housing **101**, as depicted in FIG. **19**. A cathode power-source terminal **153** is disposed in the recessed battery insertion portion **200** on the bottom thereof and an anode power-source terminal **154** is disposed in such a manner that it is exposed to the inner circumferential surface of the battery insertion portion as shown in FIG. **37**. The power-source terminals **153**, **154** are electrically connected to the electronic circuitry on the substrate **151**.

In this embodiment, a so-called button battery is used as the battery **155**. As illustrated in FIG. **41**, the button battery (battery **155**) has the external form of a disk and possesses an outer circumferential portion **155***a* that serves as an anode. The battery **155** further has a surface portion **156** serving as a cathode. The surface portion **156** is somewhat smaller in diameter than the battery proper and protrudes from the battery proper. As a result, a step is formed between the surface portion **156** and outer circumferential portion **155***a*.

The battery insertion portion **200** for inserting the battery makes it possible for a battery holder **104** to be removably inserted, as shown in FIG. **19**. As illustrated in FIG. **38**, the battery holder **104** is formed in the general shape of a disk that is slightly larger than the battery **155**, and the outer circumferential portion thereof is formed to have hook-shaped battery retainers **104***a*, **104***b* for holding the outer circumferential edge portion of the battery **155**. Structurally, the hook-shaped battery retainers **104***a*, **104***b* grasp, at their hook-shaped distal ends, the stepped portion formed between the surface portion **156** and outer circumferential portion **155***a* of the battery **155**.

As illustrated in FIG. **39**, the battery **155** is held in the battery holder **104** by fitting its outer circumferential edge portion between the battery retainers **104***a*, **104***b*, and the battery is installed in the battery insertion portion **200**, which is located in the back side of the housing **101**, together with the battery holder **104**.

If it is attempted to fit the battery **155** between the battery retainers **104***a*, **104***b* in an upside-down attitude, i.e., with the surface portion **156** facing the side of the battery holder **104** proper, the outer circumferential edge portion (whose diameter is larger than that of the surface portion **156**) of battery **155** will meet interference from the battery retainers

104*a,* **104***b*. This means that the battery **155** cannot be installed in the battery holder **104** unless it is in the normal attitude. As a result, insertion of the battery **155** into the battery insertion portion **200**, which is formed in the housing **101**, in a state in which the polarity is incorrect is avoided. More specifically, the battery retainers **104***a,* **104***b* construct erroneous-insertion prevention means for inserting the battery **155** into the battery insertion portion **200** of housing **101** in the proper attitude.

The outer circumferential portion **155***a* serving as the anode of battery **155**, which has been inserted into the battery insertion portion **200** along with the battery holder **104**, touches the anode power-source terminal **154**, and the surface portion **156** serving as the cathode of the battery touches the cathode power-source terminal **153**.

The battery holder **104** may be formed into the shape of a quadrangular plate, as shown in FIG. **40**. The battery holder **104** may be provided with engagement projections **104***e* for engaging the edge of the opening of the battery insertion portion **200** formed in the back side of the housing **101**, and with a screw hole **104***d* for screwing down the battery holder. A screw **104***c* is passed through the screw hole **104***d* and threadedly engaged with a threaded hole formed in the housing **101**, thereby securing the battery holder **104** to the housing **101**. As depicted in FIG. **41**, the battery holder **104** has the battery retainers **104***a,* **104***b* on its rear side and retains the battery **155** between the battery retainers **104***a,* **104***b* in a prescribed polarity orientation.

In the description rendered above, the focus is on a button battery having the form of a disk, the outer circumferential portion **155***a* of which is the anode and the surface portion **156** of which is the cathode. However, this does not impose a limitation, for it is possible to construct battery holders in conformity with various battery shapes used for supplying the power of the portable electronic device **100**. In such case the erroneous-insertion prevention means for holding the battery in the proper attitude would be configured for the particular battery holder.

Though not illustrated, a reset button for restoring the set state to the state set at the time of shipping is provided on the back side of the housing **101** inside a hole formed in the housing **101**. The reset button is capable of being pushed by a pin or the like.

A protective case **160** for accommodating and protecting the portable electronic device **100** will be described with reference to FIGS. **42**A to **45**. FIGS. **42**A to **43** illustrate the appearance of the protective case **160** when it is not accommodating the portable electronic device **100**, and FIGS. **44**A to **45** illustrate the appearance of the protective case **160** when it is accommodating the portable electronic device **100**.

The protective case **160** accommodates the portable electronic device **100**, as described above, therein and protects it.

The protective case **160** comprises an upper case **161** and a lower case **162**. Abutting the upper case **161** and lower case **162** forms a closed interior space in which the portable electronic device **100** is received. The cases **161, 162** consist of a transparent synthetic resin such as polymethyl methacrylate or polycarbonate.

The cases **161, 162** have an engagement portion at one end thereof. The engagement portion is constituted by a hook-shaped engagement finger **163** provided on the upper case **161** and an engagement ring **164** provided on the lower case **162**. By inserting the engagement finger **163** into the engagement ring **164** and abutting the cases **161, 162**, a closed space can be formed inside the cases.

The other end of the cases **161, 162** is provided with a fastening portion. The latter is constituted by a screw receiving piece **170** provided on the upper case **161** and a screw insertion piece **171** provided on the lower case **162**. The screw receiving piece **170** and screw insertion piece **171** align with each other when the cases **161, 162** are abutted against each other. Passing a fastening screw **172** through a screw receiving hole formed in the screw receiving piece **170** and threadedly engaging the fastening screw **172** with the screw hole of the screw insertion piece **171** fastens the screw receiving piece **170** and screw insertion piece **171** together, thereby holding the cases **161, 162** in the abutted state.

The head portion of the fastening screw **172** is formed to have a linear groove **172***a* in which the edge of a coin is capable of being fitted. That is, the fastening screw **172** can be turned with ease by fitting the edge of a coin C into the linear groove **172***a* of the head portion, as shown in FIGS. **43** and **45**.

A plurality of through-holes **169** are provided in at least one of the cases **161, 162**, e.g., the upper case **161**. The through-holes **169** are provided at positions that will correspond to the operating elements **121, 122** of the portable electronic device **100** when the portable electronic device **100** has been accommodated in the space formed inside the cases **161, 162**.

The through-holes **169** are closed by a closure member **167** a portion of which is equipped with push-buttons **165** and resilient pieces **166**. The closure member **167** is formed from an elastic material (elastomer) and is affixed to the rear surface of the upper case **161**. Owing to elastic deformation of the resilient pieces **166**, the push-buttons **165** are capable of being moved in a direction in which they recede from the upper surface of the upper case **161**.

The closure member **167** is formed as an integral part of a sealing member **168** that forms a seal between the abutted upper case **161** and lower case **162**. By integrally forming the closure member **167** and sealing member **168** as a continuum, the member of components parts and the member of assembly steps can be reduced and manufacture can simplified.

The sealing member **168** is provided in the upper case **161** along the entire perimeter of its edge abutted by the lower case **162**. The sealing member **168** is sandwiched between the cases **161, 162** when the upper case **161** and lower case **162** are abutted against each other, thereby providing a seal between the cases **161, 162**. The sealing member **168** prevents water from penetrating into the interior of the protective case **160**. More specifically, the protective case **160** not only protects the portable electronic device **100** against vibration and impact but also can be used as a waterproof cased by virtue of the sealing member **168**.

When the portable electronic device **100** is accommodated within the protective case **160** with its display section **130** opposing the upper case **161**, as shown in FIG. **45**, each push-button comes into light contact with the pushing face of a respective one of the operating elements **121, 122** as shown in FIG. **44**. Accordingly, with the portable electronic device **100** accommodated inside the protective case **160**, pushing the push-buttons **165** makes it possible to push the push switches **157** via the operating elements **121, 122** and switch pushers **102, 103**.

It should be noted that the area of the protective case **160** opposing the display section **130** of the portable electronic device **100** when the portable electronic device **100** has been accommodated may be shaped as a concave lens. That is, by

causing the outer wall portion of this area of the protective case **160** to deform into a recessed shape, this portion will act as a concave lens and make it possible to view the display section **130** of the portable electronic device **100** in magnified form.

It should be noted that the protective case of the present invention is not limited to the slave of a video game station and can be applied broadly to various portable electronic devices.

Industrial Applicability

As described above, the protective case of a portable electronic device in accordance with the present invention protects the accommodated portable electronic device against moisture and dust and therefore is useful when carrying the portable electronic device to very moist, dusty places.

What is claimed is:

1. A removable protective case for accommodating a portable electronic device therein, said portable electronic device having at least one operating element, comprising:

a) an upper case and a lower case with a closed spaced formed therebetween when said upper and lower cases are in abutment,

b) a sealing member provided in said upper case for sealing the closed spaced when said upper and lower cases are in abutment, and

c) an engagement portion on one end of said protective case and a fastening portion on the opposite end of said protective case, said engagement and fastening portions provided for holding the upper and lower cases in abutment,

d) said upper case having at least one through-hole for accessing said at least one operating element through said upper case, said at least one through-hole being sealed by a closure member to prevent penetration and contamination of said closed space during abutment of said upper and lower cases.

2. A protective case in accordance with claim **1**, wherein said at least one through-hole is aligned with said at least one operating element for operation of said operating element through said at least one through-hole.

3. A protective case in accordance with claim **1**, wherein said closure member is formed from an elastic material.

4. A protective case in accordance with claim **1**, wherein said sealing member is formed from an elastic material.

5. A protective case in accordance with claim **1**, further comprising at least one push button provided on said closure member, said push button adapted for engagement with said operating element on said portable electronic device through said at least one through-hole.

6. A protective case in accordance with claim **2**, further comprising at least one push button provided on said closure member, said push button adapted for engagement with said operating element on said portable electronic device through said at least one through-hole.

7. A protective case in accordance with claim **1**, wherein said engagement portion further comprises an engagement ring on one of said upper or lower cases and an engagement finger on the other of said upper or lower cases, said engagement finger adapted for insertion into said engagement ring.

8. A protective case in accordance with claim **1**, wherein said fastening portion further comprises a fastener receiving piece on one of said upper or lower cases and a fastener insertion piece on the other of said upper or lower cases, said fastener receiving piece adapted for passage of a fastener therethrough, and said fastener insertion piece adapted for receiving said fastener therein.

9. A protective case in accordance with claim **8**, wherein said fastener is a threaded fastener.

10. A protective case in accordance with claim **9**, wherein said threaded fastener has a head portion with a linear groove formed thereon, said linear groove dimensioned to receive a coin to facilitate rotation of said fastener.

11. A protective case in accordance with claim **1**, wherein said closure member and said sealing member are integrally formed as a continuum.

12. A protective case in accordance with claim **1**, where said sealing member is provided along the perimeter of said upper case and is sandwiched between said upper and lower cases during abutment of such cases.

13. A protective case in accordance with claim **1**, wherein the portable electronic device is further provided with a display section, and the section of the protective case opposite the display section when the portable electronic device is contained therein is further shaped to act as a concave lens to allow for viewing of the display section through the protective case in a magnified form.

14. A protective case in accordance with claim **1**, wherein at least one of said upper and lower cases is made from a transparent material.

15. A protective case in accordance with claim **14**, wherein said transparent material comprises a transparent synthetic resin.

16. A protective case in accordance with claim **15**, wherein said transparent synthetic resin is polymethyl methacrylate.

17. A protective case in accordance with claim **15**, wherein said transparent synthetic resin is polycarbonate.

18. A protective case for accommodating a portable electronic device therein, said portable electronic device having at least one side with at least one operating element, comprising:

a) an upper case and a lower case with an interior formed therebetween when said upper and lower cases are in abutment, said interior dimensioned to accommodate said portable electronic device therein, with said upper case positioned adjacent said at least one side of said portable electronic device having said at least one operating element,

b) a resilient sealing member disposed between said upper and lower cases for sealing the interior when said upper and lower cases are in abutment,

c) said upper case having at least one through-hole for accessing said at least one operating element through said upper case, said at least one through-hole being sealed by an elastic closure member to prevent penetration and contamination of said interior during abutment of said upper and lower cases, said closure member having at least one push button adapted for engagement with said at least one operating element on said portable electronic device.

19. A protective case in accordance with claim **18**, wherein said at least one through-hole is positioned opposite said at least one operating element for push button operation of said operating element through said protective case.

20. A protective case in accordance with claim **18**, further comprising an engagement portion on one end of said protective case, said engagement portion further comprising an engagement ring on one of said upper or lower cases and an engagement finger on the other of said upper or lower cases, said engagement finger adapted for insertion into said engagement ring.

21. A protective case in accordance with claim **20**, further comprising a fastening portion on the end of said protective case opposite said engagement portion, said fastening portion further comprising a fastener receiving piece on one of said upper or lower cases and a fastener insertion piece on the other of said upper or lower cases, said fastener receiving piece adapted for passage of a fastener therethrough, and said fastener insertion piece adapted for receiving said fastener therein.

22. A protective case in accordance with claim **21**, wherein said fastener is a threaded fastener having a head portion with a linear groove formed thereon, said linear groove dimensioned to receive a coin to facilitate rotation of said fastener.

23. A protective case in accordance with claim **18**, wherein said closure member and said sealing member are integrally formed as a continuum.

24. A protective case in accordance with claim **23**, where said sealing member is provided along the perimeter of said upper case and is sandwiched between said upper and lower cases during abutment of such cases.

25. A protective case in accordance with claim **18**, wherein the portable electronic device is further provided with a display section, and the section of the protective case opposite the display section when the portable electronic device is contained therein is further shaped to act as a concave lens to allow for viewing of the display section through the protective case in a magnified form.

26. A protective case in accordance with claim **18**, wherein at least one of said upper and lower cases is made from a transparent material.

27. A protective case in accordance with claim **26**, wherein said transparent material comprises a transparent synthetic resin.

28. A protective case in accordance with claim **27**, wherein said transparent synthetic resin is selected from the group of polymethyl methacrylate or polycarbonate.

29. A protective case for accommodating a portable electronic device therein, said portable electronic device having a plurality of operating elements and a display section, comprising:

a) an upper case and a lower case with an interior space defined by the abutment of said upper and lower cases, said interior space dimensioned to receive and enclose said portable electronic device,

b) said portable electronic device arranged within said interior space such that the upper case is positioned opposite the operating elements and the display section during the abutment of said upper and lower cases,

c) an elastic sealing member provided along the perimeter of said upper case for sealing the interior space during the abutment of said upper and lower cases, and

d) an engagement portion on one end of said protective case and a fastening portion on the opposite end of said protective case, said engagement and fastening portions provided for holding the upper and lower cases in abutment,

e) said upper case having a plurality of through-holes for accessing said operating elements, said through-holes arranged for alignment with the operating elements of said portable electronic device,

f) said plurality of through-holes sealed by an elastic closure member integrally formed as a continuum with said sealing member,

g) said closure member provided with push buttons arranged for pressing engagement with said operating elements, said push buttons arranged on said closure member within said through-holes, said push buttons further seated on resilient pieces that enable movement of said push buttons into engagement with said operating elements.

30. A protective case in accordance with claim **29**, wherein said engagement portion further comprises an engagement ring on one of said upper or lower cases and an engagement finger on the other of said upper or lower cases, said engagement finger adapted for insertion into said engagement ring.

31. A protective case in accordance with claim **30**, wherein said fastening portion further comprises a fastener receiving piece on one of said upper or lower cases and a fastener insertion piece on the other of said upper or lower cases, said fastener receiving piece adapted for passage of a threaded fastener therethrough, and said fastener insertion piece adapted for receiving said threaded fastener therein.

32. A protective case in accordance with claim **31**, wherein said threaded fastener has a head portion with a linear groove formed thereon, said linear groove dimensioned to receive a coin to facilitate rotation of said fastener.

33. A protective case in accordance with claim **29**, wherein the section of said protective case opposite the display section when the portable electronic device is contained therein is further shaped to act as a concave lens to allow for viewing of the display section through the protective case in a magnified form.

34. A protective case in accordance with claim **29**, wherein the upper and lower cases are made from a transparent material.

35. A protective case in accordance with claim **34**, wherein said transparent material comprises a transparent synthetic resin.

36. A protective case in accordance with claim **35**, wherein said transparent synthetic resin is polymethyl methacrylate.

37. A protective case in accordance with claim **35**, wherein said transparent synthetic resin is polycarbonate.

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